A POPULAR MECHANICS BOOK

23 BOATS YOU CAN BUILD

STEP-BY-STEP INSTRUCTIONS, PICTURES AND PLANS

23 BOATS YOU CAN BUILD

The kind of a boat you'd like to have is sure to be within the covers of this book. In 23 BOATS YOU CAN BUILD, the editors of Popular Mechanics present a wide variety of craft—ranging from "Seacraft," a 25-foot cabin cruiser sleeping four persons, to "Tiny," a six-footer that flaunts a muslin sail from a boom made of a sawed-off broomstick.

There's "Su-Lu," a plywood dinghy built like a Navy PT-boat . . . three boats of sheet plywood . . . an eight-foot duckboat for sportsmen . . . a three-section rowboat that fits inside itself like a Chinese box puzzle . . . a Canadian-type canoe . . . a kayak of the North . . . a pontoon boat pedal-powered by a converted bicycle . . . a sea sled that runs on a converted washing-machine engine . . . a racing ice boat that will take you skimming along at more than 80 miles an hour . . . a motor-driven catamaran . . . a paddle-propelled pontoon.

But don't get the idea that all the boats in 23 BOATS YOU CAN BUILD are oddities. Most of them are sturdy, sensible craft—just the kind you want for vacationing, fishing or hunting waterfowl. All have been chosen because they are easy to build, requiring only limited tools and no experience. Each boat is presented with step-by-step, easy-to-understand instructions. There are layout plans, working drawings and pictures of the actual boats under construction. Material lists tell you just what and how much to order in the way of lumber, hardware, fittings, sailcloth, etc.

"Build Your Boat Right" is a section of valuable introductory information for the amateur boatbuilder, giving detailed hints and precautions for laying out plans, building frames and keel, assembling and laying planking, installing engines, rudders and masts, and caulking and painting. Another general section, "Seamanship and Servicing Your Boat," tells how to sail, mend torn sails, and repair and service all types of boats.

23 BOATS

You Can Build

Compiled by the Editors of
Popular Mechanics Magazine

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Foreword

Boatbuilding is part of the American heritage. The settlers of New England developed the sturdy dory to cope with the storm-wracked Atlantic waters in which they fished. It was a rare son of Maine or Massachusetts who could not fashion his own boat with crude hand tools. The rivers of America were explored by men who learned from the Indians how to make bark and dugout canoes. Flatboats carried a large part of the goods of the pioneers during the westward movement. Today, boatbuilding is no longer a part of everyday life, except in some fishing communities where boats still are built by men who earn their livelihood from them. But there are a surprising number of amateur boatbuilders.

Altogether there are more than half a million persons in the United States who are regularly building boats for pleasure or for profit. They form a cross section of American life. The sleek mahogany cabin cruiser of the Chicago banker shares Belmont Harbor with the plywood sailing dinghy of the shipping clerk. On Chesapeake Bay, in the Florida Keys, and through San Francisco's Golden Gate, the rich man's self-designed yacht and the home-built sloop of the ordinary man head out toward the open sea together. Self-built canoes and rowboats of fishermen and hunters glide on the inland rivers of the country, and on its lakes, ponds and marshes. Theirs is a double reward—the pride of craftsmanship and the thrill of navigating the boat when the building is done.

With all this in mind, the editors of Popular Mechanics have chosen with care the craft that make up the contents of *23 Boats You Can Build*. Boats built from these plans are now in successful operation in various parts of the country. The instructions, pictures and plans were prepared for ease of understanding. Those who have never built a boat before are urged to read Part 9, "Build Your Boat Right," which begins on page 161. The editors believe this book offers something to tempt every lover of boats—a plan that will make his hands itch for tools and materials. Choose your favorite—cabin cruiser, sailboat, rowboat, inboard, outboard, ice yacht, bicycle boat, canoe, kayak, sea sled, paddle board, catamaran. Good building, happy launching, and *bon voyage!*

The Editors

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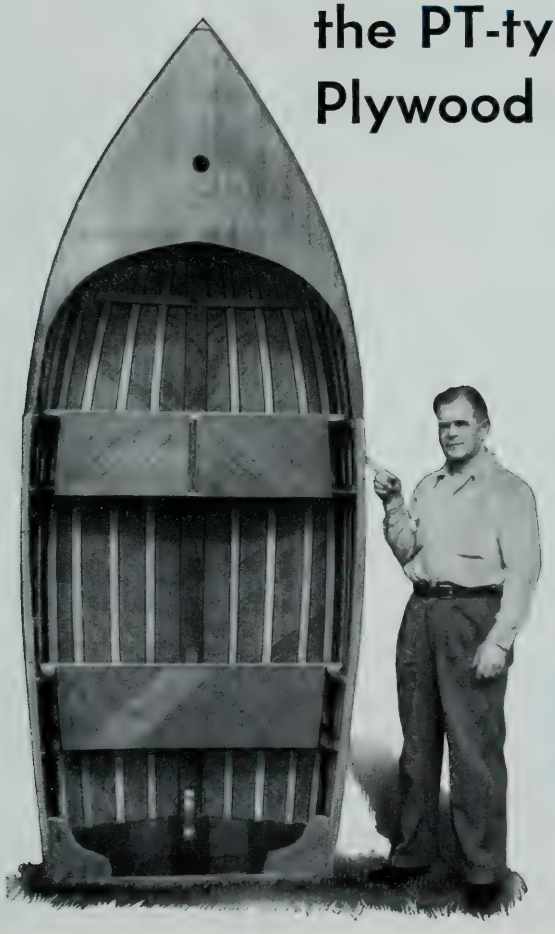
PART 1

"Su-Lu" - -
the PT-type Plywood Dinghy



Robert L. Smith, Monrovia, Calif., builder of the original "Su-Lu," holds the light but sturdy boat upright with one finger. There are no hidden props — believe us!

With two passengers aboard, "'Su-Lu" planes the water like Navy PT boats, after which it was patterned

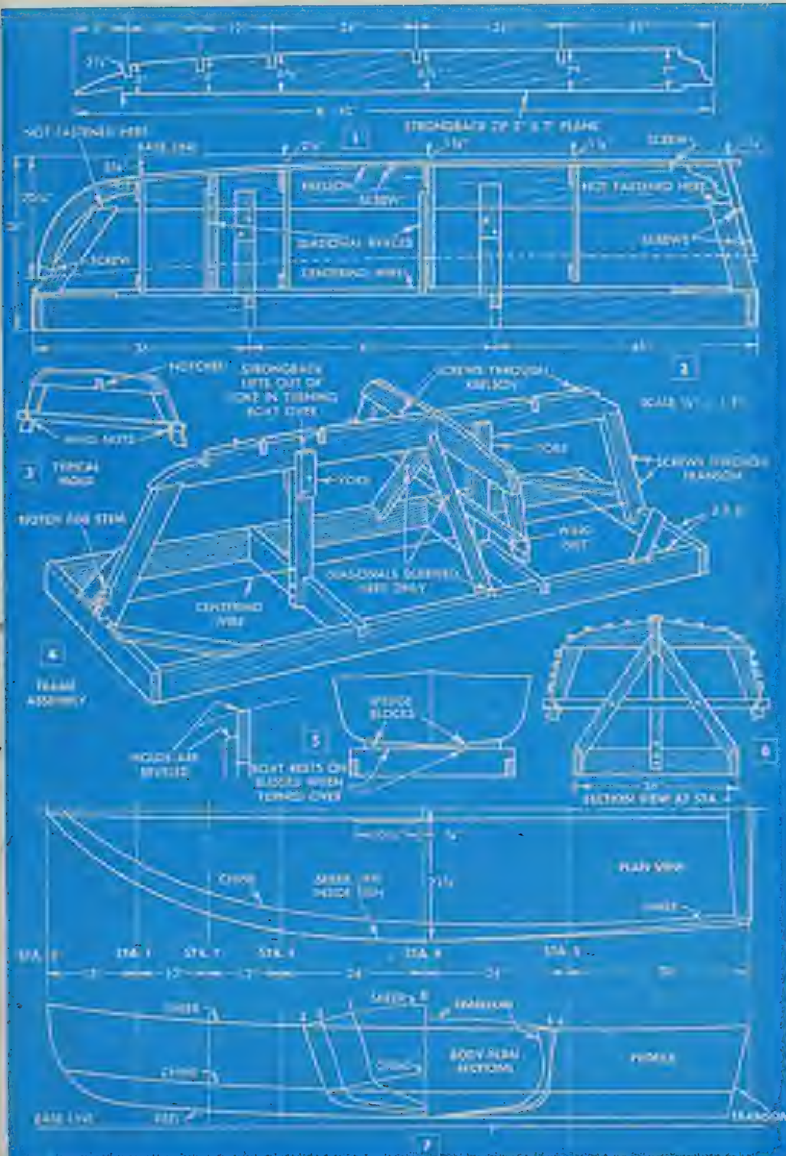
"Su-Lu" -- a Plywood Dinghy

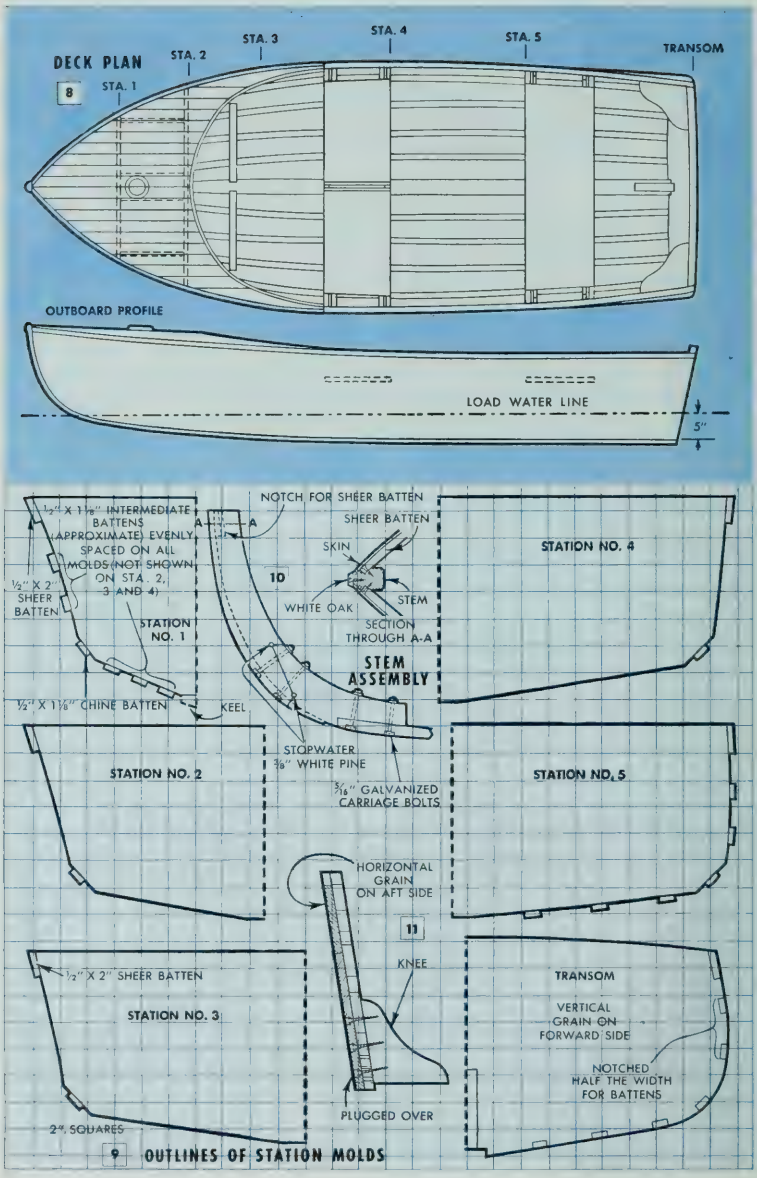
THIS LIGHT and sturdy little dinghy is actually a 10-ft. model of a Navy PT hull, that is, with adaptations to the materials used and to the limitations of a home workshop. "Su-Lu" can accommodate four adults and is light enough for one person to put on top of a car. The "skin" is merely two layers of ⅛-in. plywood with muslin between, laid over a frame of spruce battens. The result is a rigid, strong but very light shell. The transom is built to take an outboard motor, and a mast step and centerboard trunk are provided for sailing purposes. Oarlocks and sockets also may be provided, though not shown on this model.

Erecting frame: Once the strongback and station molds are properly installed on the erecting frame, the shape of the hull is bound to be correct. As in all small boats, it is most convenient to build upside down and the erecting frame is thus designed. First make the strongback, Fig. 1, of a 2 x 7 plank, notched to receive the five station molds and cut away to clear stem and transom knee. If your workshop has a wooden floor you can set up the erecting frame directly upon it. If a concrete or dirt floor is used, however, you should make a large open rectangle of planks with corner braces and cross members upon which uprights are supported, as in Fig. 4, which in turn carry the strongback. Note that the strongback is also supported at the end by 2 x 4s, but that these are not screwed to it, in order that when the boat is lifted up to be turned over, the strongback will come away. This applies also to the upright supports amidships. A taut wire is installed as shown by which the station molds are to be centered. In Fig. 2 is a side view of the erecting frame with stem, transom and keel in place. These are temporarily secured with screws for removal when the boat is turned over, and so that the stem can be taken off for cutting the batten notches after marking them while on the frame. Diagonal braces are located where indicated, and these are screwed to the frame only at the bottom

TABLE OF OFFSETS IN FEET, INCHES AND EIGHTH INCHES TO INSIDE OF SKIN

Heights	Station	0	1	2	3	4	5	T
above	Sheer	1-8-2	1-6-7	1-5-5	1-4-6	1-4-1	1-4-3	1-4-3
base	Chine		0-7-2	0-6-0	0-5-2	0-4-4	0-4-5	0-4-6
line	Keel		0-3-3	0-2-1	0-1-5	0-1-1	0-1-1	0-1-1
Half-	Sheer		1-0-3	1-5-4	1-8-3	1-9-6	1-8-7	1-6-3
breadths	Chine		0-8-4	1-1-5	1-4-2	1-7-0	1-7-2	1-5-5
	Keel		0-0-6	0-0-8	0-1-4	0-1-4	0-1-4	0-1-4


NOT FASTENED HERE
KEELSON
SCREW
CENTERING WIRE
SCREWS THROUGH KEELSON
YOKE
SCREWS THROUGH TRANSOM
NOTCH FOR STEM
CENTERING WIRE
FRAME ASSEMBLY
WEDGE BLOCKS
PLAN VIEW
CHINE
SHEER
BODY PLAN SECTIONS
PROFILE
TRANSOM
BASE LINE
KEEL


DECK PLAN
8
STA. 1
STA. 2
STA. 3
STA. 4
STA. 5
TRANSOM
OUTBOARD PROFILE
LOAD WATER LINE
5"
½" X 1⅛" INTERMEDIATE BATTENS (APPROXIMATE) EVENLY SPACED ON ALL MOLDS (NOT SHOWN ON STA. 2, 3 AND 4)
½" X 2" SHEER BATTEN
STATION NO. 1
½" X 1⅛" CHINE BATTEN
KEEL
NOTCH FOR SHEER BATTEN
SHEER BATTEN
SKIN
WHITE OAK
STEM
SECTION THROUGH A-A
10
STEM ASSEMBLY
STOPWATER ⅜" WHITE PINE
⅜" GALVANIZED CARRIAGE BOLTS
STATION NO. 4
STATION NO. 2
STATION NO. 5
HORIZONTAL GRAIN ON AFT SIDE
11
KNEE
½" X 2" SHEER BATTEN
STATION NO. 3
TRANSOM
VERTICAL GRAIN ON FORWARD SIDE
NOTCHED HALF THE WIDTH FOR BATTENS
PLUGGED OVER
2" SQUARES
9
OUTLINES OF STATION MOLDS

where they will be accessible for a screwdriver. These are illustrated in the sectional view, Fig. 6. Their purpose is to keep the station molds centered during construction. After the hull is completed and lifted off, it is set on the frame base with wedge blocks, as in Fig. 5.

Station molds: As long as the profiles are correct, the station molds may be of almost any type, and Fig. 3 is only a suggestion. Note that the cross brace is assembled with wing nuts for easy removal. Ordinary screws may be used instead of wing nuts. In placing the molds on the strongback, notches should be cut deep enough to permit the bottom of the mold to lie flush with the edge of the strongback. Also, the edges should be beveled to conform to the curve of the hull.

In Fig. 8 are shown the deck plan and outboard profile of the finished hull, without the false bottom or sailing equipment. Note the oversize knees at corners of transom, which can serve as seats in handling the tiller under sail or on other occasions.

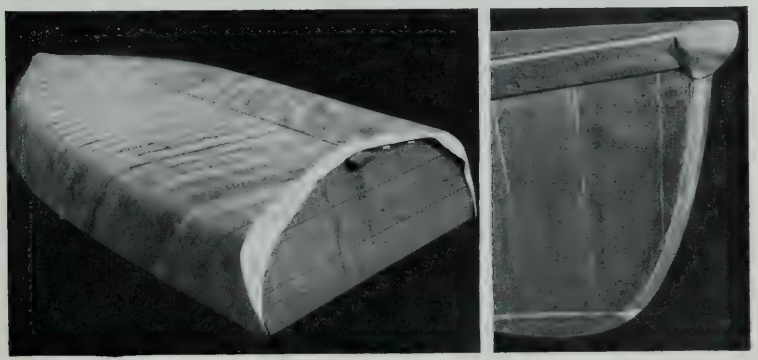
Profiles of the five station molds are given in Fig. 9. Approximate locations of the battens are indicated on Station 1 only. Sheer and chine battens are indicated on the others. After the molds are completed, make the keel of white oak, ¾ in. x 3 in. x 9 ft. Part of this will be cut off the aft end later. At a point 30 in. from the forward end, it begins to taper from 3 in. wide to 1½ in. at the forward end. A slot for the centerboard, ⅜ in. x 10½ in., is cut through where indicated in the upper detail of Fig. 7. The keelson is secured temporarily to the strongback with screws as indicated in Fig. 2 and also to stem and transom.

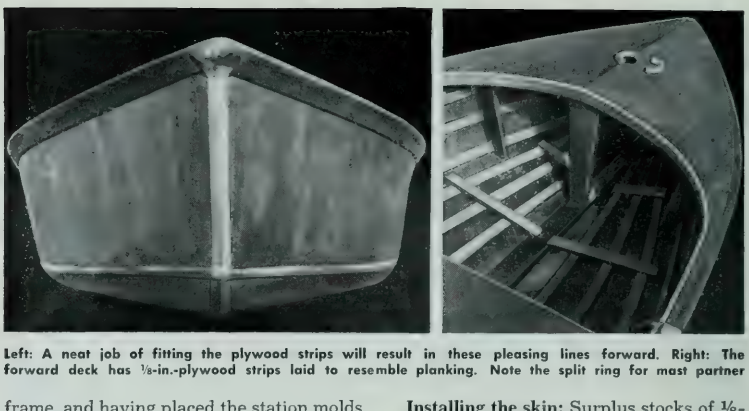
The stem: The stem may be made of white oak, apitong, or, as in this case, mahogany. Two ¾-in. pieces are glued together to form 1½-in. thickness. It is made in two parts, Fig. 10, the joint being bolted and glued and provided with stopwater plugs of soft pine. Installed dry, these plugs swell to a very tight fit and prevent leaking at a critical point. The two parts are bolted with galvanized carriage bolts, the heads countersunk. In the final assembly, bolts are used to fasten to keelson. Cut the stem longer at the top than shown to allow for trimming flush with the top of the sheer battens. Bevel the forward edge somewhat to simplify getting marks for batten notches, and later plane the edge flush with the battens to receive the plywood skin in a watertight joint. In all assembly operations on this boat, use a waterproof cement recommended for this purpose.

The transom: An exceptionally strong transom is made by building up two layers of ¾-in. mahogany with the grain at right angles and the profile as shown in Fig. 11. The grain is vertical on the forward side and horizontal on the after side. This construction also simplifies making the notches for the battens, which can be sawed instead of chiseled out. The transom knee is also shown in Fig. 11, and is installed with galvanized flathead wood screws, heads countersunk and plugged over with marine dowels. Use this type of dowel exclusively on the boat because the grain runs across and they can be trimmed flush with the boat neatly with a chisel. Note that notches for battens are only half way through the transom, while the notch for the keelson goes all the way through.

Installing battens: The sheer line should be marked on stem as well as station molds before beginning to install battens. With keelson, stem and transom on the erecting

Left: Cloth between inner and outer layers of plywood has not yet been trimmed at transom. Note bevel on keelson, end of which is to be sawed off flush. Right: Steam-bent oak cutwater is shown screwed on over cloth gasket





Left: A neat job of fitting the plywood strips will result in these pleasing lines forward. Right: The forward deck has ⅛-in.-plywood strips laid to resemble planking. Note the split ring for mast partner

frame, and having placed the station molds in proper notches, check to make sure that they are absolutely square with the strongback and centered with the guide wire. The transom should also be checked for square.

Screw each sheer batten in its notch in the transom, nail them temporarily at the sheer mark on Station 4, Fig. 16, then draw the forward ends together simultaneously at the stem and nail just enough to hold in position, Fig. 17. The object of drawing both battens together at the stem at the same time is to avoid twisting the molds, as could happen if only one were installed at a time. In this case the stiff batten would tend to force the molds inward.

The battens from Station 4 to the stem should be steamed or boiled for at least 20 minutes. This can be done in a length of iron pipe propped at an angle, with a fire under the lower end. Soaking in a pool or water trough also will render the battens pliable, but the hot water and steam treatment is more effective.

Next install the chine battens, drawing the forward ends together simultaneously and nailing temporarily to the stem. They should assume a natural curve. The intermediate battens may be placed one at a time. When all are nailed to the stem temporarily, space them equally distant on the station molds, except where it involves undue strain, and drive nails part way in to retain the positions. The frame will then appear as in Fig. 17. Now mark the stem where each batten contacts it, draw out the nails, remove the stem and chisel in the notches. Replace the stem on keelson, cut ends of battens to correct length, set in notches and screw down permanently.

With a short length of batten used as a fid, test for the angle the keelson is to be planed so that the skin will lie flat on it.

Installing the skin: Surplus stocks of ⅛-in. mahogany plywood are available and make ideal material for covering this hull. It is laid on in strips of varying widths, determined by trial in fitting. The inner layer is begun at the transom, Fig. 13, and the strips are laid diagonally. Use as wide a piece as will contact the battens at every point as you work forward. All strips must be shaped and nailed on temporarily before any of them are glued. Use escutcheon nails and heat the area to be bent by pressing on both sides with a hot iron through a damp cloth, Fig. 12. You will need to work fast before the plywood cools to make a clean bend. Any strips fractured in the process should be discarded after using them as a pattern for a new strip. The nails through the battens into the station molds must be removed before the plywood is installed permanently. Otherwise you will have serious difficulty in getting the molds out of the hull after it is turned over.

Now begin cementing the skin to the battens. Leave all the temporarily nailed strips in place except the one you are working on and that adjoining it. A ½-in. acid brush with a metal handle is handy for applying the cement. All contacting surfaces should be thoroughly coated. Lay a strip of cloth under the first plywood layer, along the edges of transom and stem, with cement.

In driving the escutcheon nails through the plywood into the keelson, be sure they are spaced at least 1¼ in. apart along the center so that they will not interfere when the area is planed flat to receive the keel strip, Fig. 14.

After the first layer is installed from transom to stem, sandpaper the surface thoroughly to receive the muslin. Before applying cement, stretch the sheet (72 in. wide) over the hull, tack along edges and

Su-Lu racked on a car, ready for the road, with little wind resistance in its smart lines

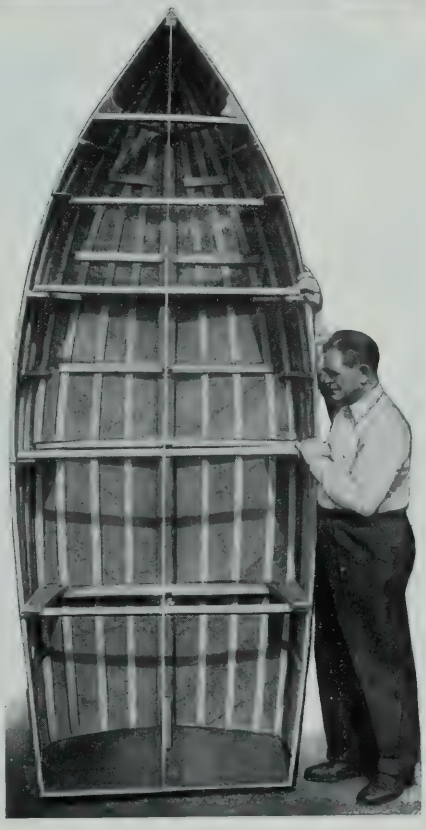
trim, but allow a few inches extra all around to be cut away later. The only opening should be at the centerboard slot and along the stem. Remove the cloth and apply cement over the entire hull, working rapidly and carefully. Then replace the muslin and stretch it taut over the entire surface, smoothing out even the slightest wrinkle. This last precaution is important as a wrinkle might cause an air pocket and the start of decay.

The second or outer layer of plywood is laid the same as the first, except that it lies at right angles to the original strips, Fig. 13. To insure the nails hitting the battens all along, marks should be made on the first layer to locate them properly, then duplicated on the canvas.

After the cement has set, sandpaper the surface smooth to receive the spar varnish. Around the transom put a cover strip over the edges of the exposed plywood skin. The cover strip may be of ⅛-in. plywood, scrollsawed about ½ in. wide and cemented as well as escutcheon-nailed, Fig. 15.

Ends of the plywood should project over the stem so that a clean surface can be made by sawing flush with the cutwater to receive the oak strip covering the joint.

Turning boat over: By removing the screws through the keelson into the strongback, those through stem and transom into the fore and aft



The forward station molds are replaced by deck beams. Others await fitting of seats

2 x 4s, and those at the foot of the diagonal braces (see Figs. 2 and 4) the hull can be lifted off and turned over. Set it on blocks on the base frame as in Fig. 5 and it is ready for interior finishing.

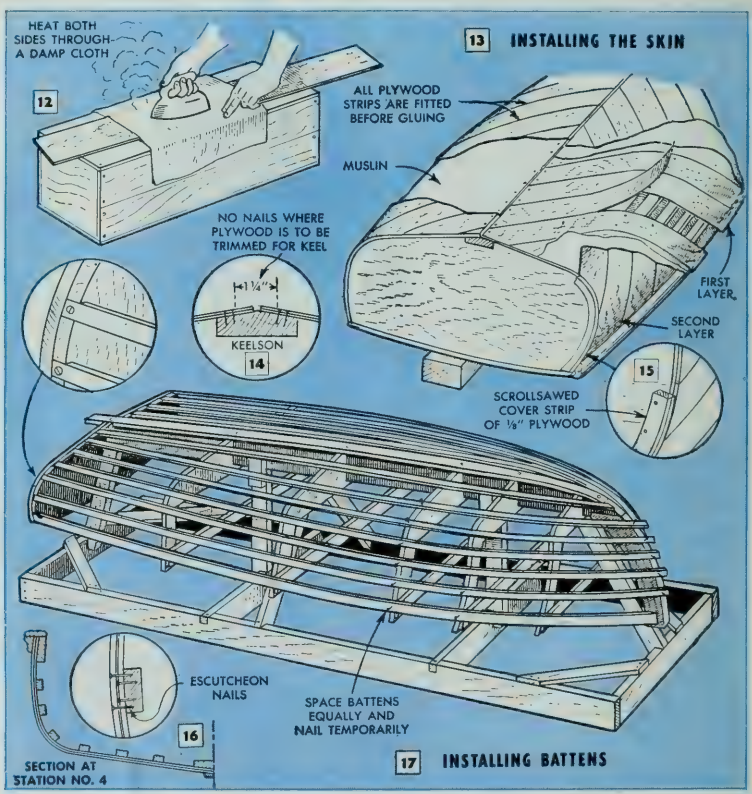
Saw the ragged edges of the skin flush with the sheer battens and the stem. Because it has hardened with cement, the cloth will not snag the saw. Station molds should be left in until the forward deck beams and seats are installed to prevent the sides "squeezing" inward. By removing the cross member of Station mold No. 5, the strongback can be lifted out over the transom. A sectional view at Station 4 shows the thin but sturdy planking structure and arrangement of the escutcheon nails in the battens, Fig. 16.

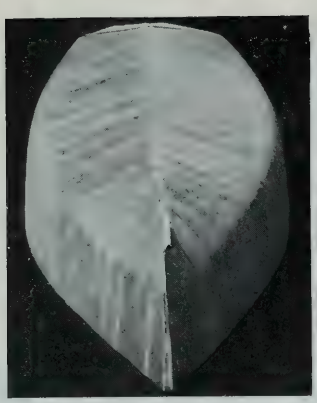
A general view of the detailed assembly is shown by the partial perspective, Fig. 20.

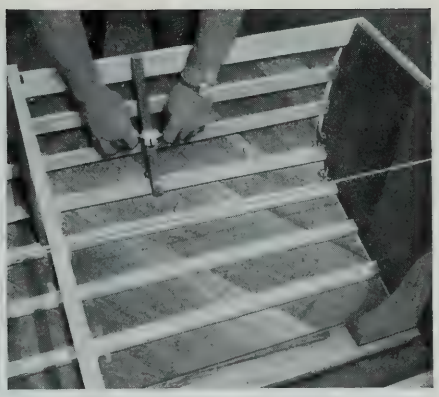
Install the deck beams at Stations 1 and 2, together with the diagonal braces under the first section and the knees, as shown. The knees and the breasthook can be made of two thicknesses of ¾-in. scrap mahogany. A mast step with a hole 1¾ in. square is shown here on the keelson, but should not be permanently installed until the mast partner is located in the deck. Behind the second deck beam install a curved, steam-bent oak member for the after edge of the deck. The molding is screwed to this member after the deck is completed.

Seats are supported on short ribs with ½-in.-plywood panels, as in Fig. 20. The seat top is ½-in. plywood. In the original model shown in the photographs, ⅛-in. mahogany was laid over ⅜-in. Douglas-fir plywood, making an attractive finish.

The assembly of the built-up transom is







Left: Hull lifted off erecting frame, rough with cement. Right: Trimming the short rib which is to be the seat support. Note cloth strip between skin and edge of transom. Beam at left is on Station mold No. 5

shown in Fig. 19. The transom has an oak cover strip across the curved top.

Centerboard trunk: The centerboard trunk accommodates a duralumin or dural-steel keelboard. The trunk is constructed of plywood sides with oak end members and oak cleats securing it to the keelson. The trunk also serves as a support for the amidships seat. A cloth gasket is placed over the keelson, as illustrated in Fig. 21. The inner walls should be given a thorough application of bottom paint before final assembly.

Deck and trim: Returning to Fig. 20, an oak rub rail runs from stem to transom. From the front of the amidships seat to the transom is an oak cover strip. Having plenty of ⅛-in. plywood on hand, the deck of this boat was built up of three layers, the center one with the grain at right angles to the upper and lower ones, as shown in Fig. 18. A sturdy enough deck can also be made of one panel of ⅜-in. plywood. In the three-layer arrangement, the plywood is laid in 2-in. strips, giving the attractive appearance of a planked deck, as illustrated in the photographs.

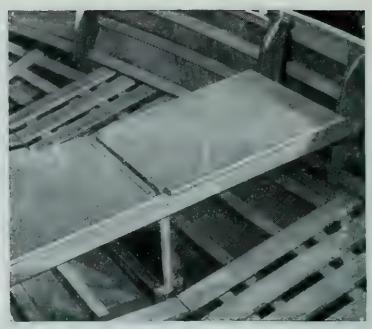
With the exception of the bottom below the water line, which is given two coats of bottom paint, the entire hull is spar-varnished. No stain is required, the natural wood having a very pleasing appearance.

Mast: With 12 ft. of mast above deck and an 8-ft. boom, the little plywood dinghy makes a fleet sailer and is exceptionally trim in her lines, Fig. 22. The mast rests in a step on the keel. Following the preference of many sailing-dinghy enthusiasts, no shrouds are used, a single forestay anchoring the mast. Note that the boom is kicked up well aft, making it unnecessary for you to dive into the boat when coming about.

A sturdy but light hollow mast is easily constructed as in Fig. 23. Select two pieces of vertical-grain spruce 1¼ in. x 2½ in. x 13 ft. 4 in. Place them together and mark a 1-in. circle, then make saw cuts to within 7½ in. of one end. Now chisel a groove in each with a gouge and check with a template. Glue the halves together and with a chalk line mark a taper from 2¼ in. at the base to 1¾ in. at the top. Saw along the marks, lay on the side and repeat the process. You now have a square-section, hollow, tapered mast, to be trimmed round, first by making it octagonal with a drawshave and finishing with a plane and sandpaper.

In Fig. 24 is shown a sectional view of the completed mast. Beginning at the deck line downward the mast should be of uniform diameter, that is, approximately 2¼ in., and 4 in. from the bottom should be tapered to a square end to set in the mast step. This will prevent turning under sailing stress. To reinforce the lower end of the mast, insert a hardwood core, 32 in. long, having applied glue liberally. By glue we mean a waterproof cement, which is to be used on all contacting fixed wood surfaces in this boat. The top end of the mast is slotted for a 2-in. sheave, which can be lathe-turned from hardwood and should have at least 1/16-in. clearance on each side so that it will not bind from the effect of swelling in moisture. Drive a ferrule on the peak of the mast.

Boom: A flat boom is shown in the sail plan, Fig. 22. This is a favorite type among owners of light sailing craft as it conforms to a certain degree to the curve of a well-filled sail. The boom is of vertical-grain



Left: Installing diagonal supports under the forward deck beam. Right: Strong, light, removable floor boards

spruce stock, ¾ in. x 3 in. x 8 ft. 3 in., slightly tapered at the forward end, Fig. 26. It is equipped with blocks and sail track and cleat, as shown, and hinged to the mast with a gooseneck, Fig. 25. The gooseneck can be made up if you have adequate metalworking equipment, or a used one might be found at a marine hardware store. For salt-water use, all hardware must be bronze, brass or stainless steel.

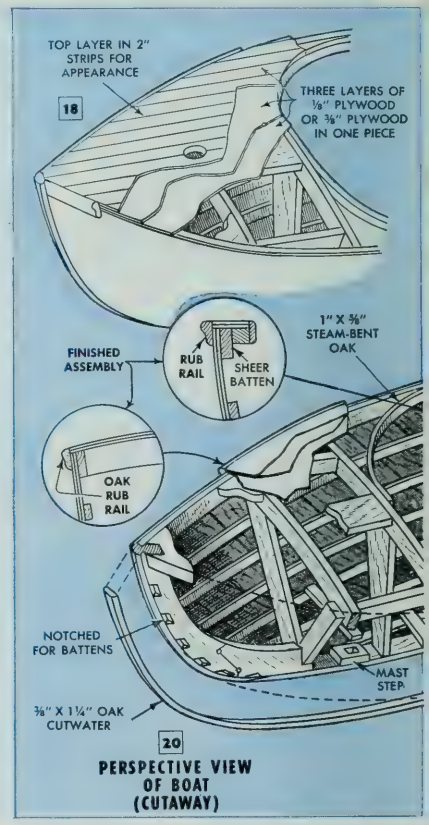
For those who prefer the round-section boom, a design is given in Fig. 27. This tapers from the center toward the ends, one of which is slotted for a sheave.

Deck fittings: In Fig. 28 is illustrated a simple arangement of deck fittings, including a halyard cleat on the mast, a mooring cleat forward of the mast on the deck, and a pair of bow chocks. The forestay is secured to an eyebolt in the top of the stem. If shrouds are desired, chain plates are made as in Fig. 33. Strap metal is hooked under the sheer battens and carried up through slots in the deck. Forestay and shrouds should be 3/32-in. 6 x 7 galvanized wire or 1/16-in. 19-strand stainless-steel cable.

Centerboard and rudder: For the centerboard, cut 3/16-in. dural steel to the outline shown in Fig. 29, with a wood bar bolted or riveted across the top. Grind the edges round so that they will not cut exposed flesh or snag on clothing in handling.

The rudder is scrollsawed from a single mahogany board, 12 x 36 x ¾ in. thick, Fig. 30. To prevent warping or splitting under extreme load, rabbet across for recessed oak battens ⅜ in. thick and 2 in. wide. Cement one on each side, as indicated in the drawing. Edges below the water line should be rounded.

A tiller with a curve is easy to manage as well as pleasing to the eye. One can be made as in Fig. 31, by steam-bending a length of hickory or oak. When dry, trim

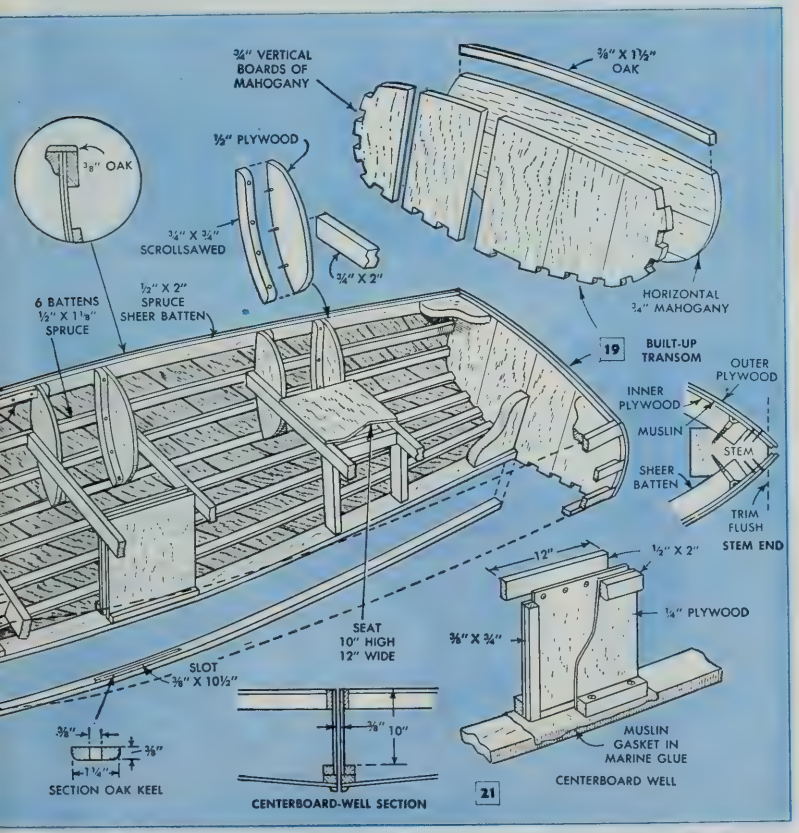


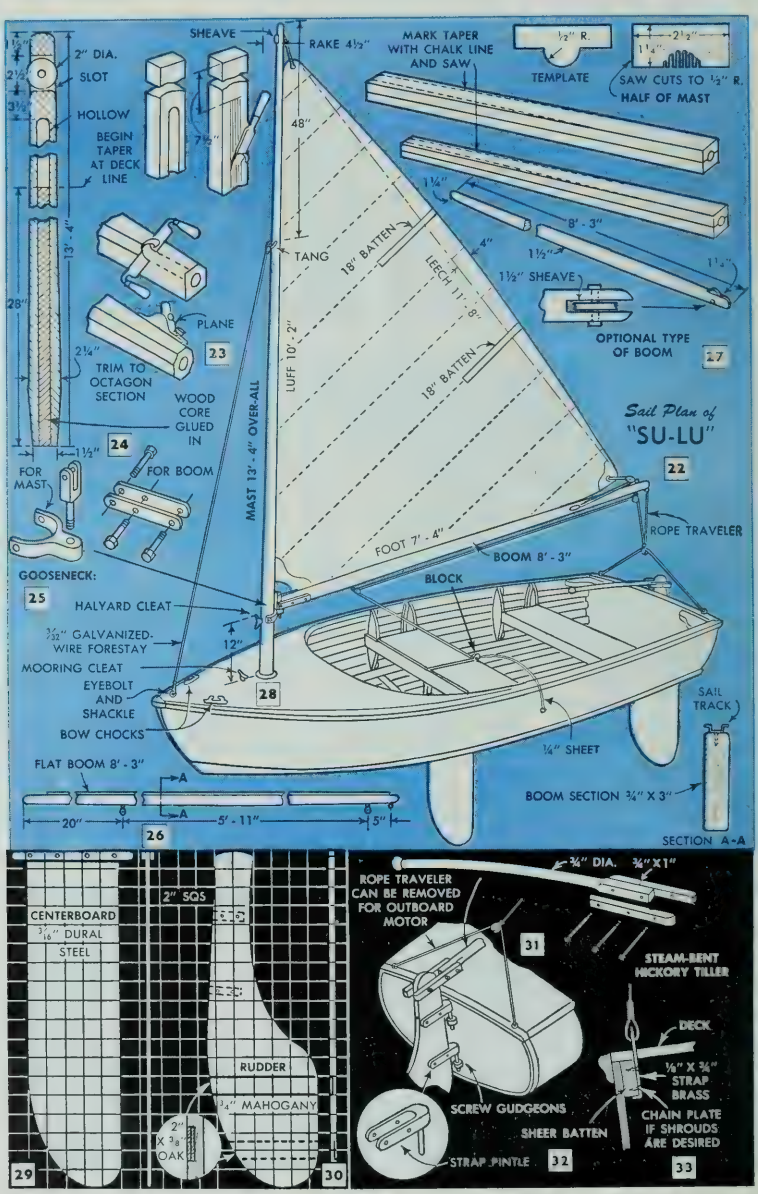
it to a round section at the forward end. Cheek-pieces are bolted on to straddle the shank of the rudder. The rudder is hung on screw gudgeons with strap pintles, Fig. 32. If you make the rudder yourself, bear in mind that the tapered pin on the lower edge should be longer than on the upper for convenience in placing in the gudgeons.

In order to leave the transom clear for an outboard motor, a rope traveler is recommended, as it can be unsnapped quickly and stowed when power is required.

Summary: A number of strip-plywood boats have been built since the original Su-Lu, and all the makers reported excellent results from following this basic design. Despite their respectable lengths of around 10 ft., and the roomy 42-in. beams, the boats made have averaged less than 100 pounds.

None of the builders got into serious difficulties. As may be gathered from the instructions, the only ticklish part of the whole operation is that involving the steaming, bending and fitting of the plywood strips. The original builder, Robert L. Smith, a Monrovia, Calif., bank employee, had never built a boat before he constructed the original Su-Lu. He departed from the instructions given here in only one major instance—installing both plywood layers at the same angle rather than at right angles. Some strength is sacrificed by this method, and later builders adopted the crossed strips. Smith's next boatbuilding project was to be a 16½-ft. boat, one fifth the size of a Navy PT boat.




SHEAVE
RAKE 4½"
MARK TAPER WITH CHALK LINE AND SAW
½" R.
TEMPLATE
2½"
1¼"
SAW CUTS TO ½" R.
HALF OF MAST
2" DIA.
SLOT
HOLLOW
BEGIN TAPER AT DECK LINE
7½"
48"
1¼"
8' - 3"
1½"
1¼"
TANG
18" BATTEN
LEECH 11' - 8"
4"
1½" SHEAVE
OPTIONAL TYPE OF BOOM
27
13' - 4"
28"
PLANE
23
2¼"
TRIM TO OCTAGON SECTION
WOOD CORE GLUED IN
24
1½"
LUFF 10' - 2"
18" BATTEN
Sail Plan of "SU-LU"
22
FOR MAST
FOR BOOM
MAST 13' - 4" OVER-ALL
FOOT 7' - 4"
BOOM 8' - 3"
ROPE TRAVELER
GOOSENECK:
25
BLOCK
HALYARD CLEAT
3/32" GALVANIZED-WIRE FORESTAY
12"
MOORING CLEAT
EYEBOLT AND SHACKLE
28
BOW CHOCKS
SAIL TRACK
¼" SHEET
FLAT BOOM 8' - 3"
A
A
20"
5' - 11"
5"
26
BOOM SECTION ¾" X 3"
SECTION A-A
CENTERBOARD
3/16" DURAL STEEL
2" SQS
RUDDER
¾" MAHOGANY
2" X 3/8" OAK
29
30
¾" DIA.
¾" X 1"
ROPE TRAVELER CAN BE REMOVED FOR OUTBOARD MOTOR
31
STEAM-BENT HICKORY TILLER
DECK
⅛" X ¾" STRAP BRASS
SCREW GUDGEONS
SHEER BATTEN
STRAP PINTLE
32
CHAIN PLATE IF SHROUDS ARE DESIRED
33

Though packed to the gunwales with passengers, Su-Lu rides the waters buoyantly because of light construction

MATERIAL LIST

HULL LUMBER

1 piece white oak, ¾ x 3 in. x 9 ft.—for keelson
1 piece spruce, ½ x 2 in. x 10 ft. 3 in.—for battens
12 pieces spruce, ½ x 1⅛ in. x 10 ft. 3 in.—for sheer battens
16 sq. ft. mahogany, ¾ in. (glued up to 1½ in. thickness) — for transom, stem and knees
1 piece mahogany or pine, ¾ x 3 in. x 6 ft.—for deck beams
22 lineal ft. mahogany, ¾ x 2 in. x diagram —for seat rails
2 pieces white oak, 1 x 1 x 12 in.—for centerboard-well cleats
22 lineal ft. white oak, ⅜ x 1¼ in. x diagram —for keel-strip molding
2 pieces oak, ¾ x 1½ in. x 10 ft. 6 in.—for rub rails
8 sq. ft. plywood (covered with mahogany plywood), ⅜ in.—for seats
4 panels mahogany, basswood-core plywood, ⅛ x 40 x 60 in.—for planking (skin)

HARDWARE

1½ lbs. ½ in. escutcheon nails
2 5/16 x 2½ in. galvanized carriage bolts—for stem
2 5/16 x 3½ in. galvanized carriage bolts—for stem
12 No. 14 2½ in. flat-head wood screws—for transom knee
1 gross No. 7 1¼ in. flat-head wood screws —for transom knee
Waterproof cement, spar varnish

MAST AND RIGGING

2 pieces spruce, 1¼ x 2½ in. x 13 ft. 4 in.—for mast
1 piece spruce, ¾ x 3 in. x 8 ft. 3 in.—for boom
1 piece dural steel, 5/16 x 10¼ x 36 in.—for centerboard
1 piece mahogany, ¾ x 12 x 36 in.—for rudder
2 pieces oak, ⅜ x 2 x 12 in.—for battens
1 piece hickory, ¾ x 1 x 20 in.—for tiller
2 pieces oak, ¾ x 1 x 8 in.—for cheek-pieces
12 sq. yards muslin—for sail

MISCELLANEOUS

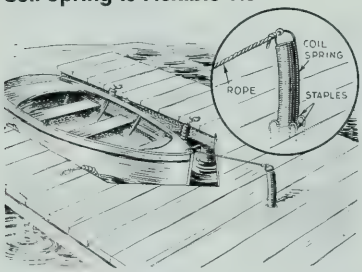
5 blocks; cleats for sheet, halyard, mooring
9 ft. 3/32 in. 6 x 7 galvanized wire for forestay, eyebolt
2 bow chocks; pair gudgeons and pintles; gooseneck
17 ft. stainless-steel sail track and riders; galvanized bolts for rudder; tang, snaps, thimbles

MOORING HINTS FOR SMALL BOATS

Mooring Ring for Rowboat

Using auto pistons with connecting rods attached as mooring rings for a boat will save pulling the boat onto the shore every time you stop on a water route frequently traveled. At convenient points along the route, the auto pistons are buried in the ground so the end of the connecting rod is exposed, and a line from the boat is secured to the rod. This method, of course, can only be used in very still water. For more permanent installations where there is a strong current, the pistons and rods can be embedded in concrete.

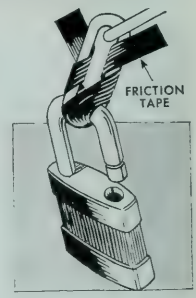
Coil Spring Is Flexible Tie



One boat owner uses a stiff coil spring as indicated to keep the boat snug in a dock berth yet allow it to move with tides or waves. The spring is 1½ in. in diameter and is fastened to the wharf with three large staples through the lower turn. A rope at the top of the spring is used to tie up the boat.

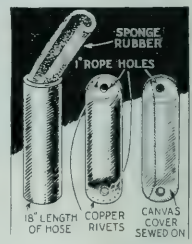
Padlock Secured to Boat Chain

To keep an opened padlock from slipping off a boat chain and being lost, fasten it to the chain with a strip of friction tape. Several turns of tape are wrapped around the bow of the padlock and the tape is entwined around the last link of the chain as shown.



Bow Fenders From Old Fire Hose

Unusually neat fenders for a small boat can be made from lengths of large hose, preferably old fire hose. This is filled with tightly rolled sponge rubber, after which the ends are copper-riveted together. A canvas cover for each fender improves its appearance and provides a good base for painting if desired.



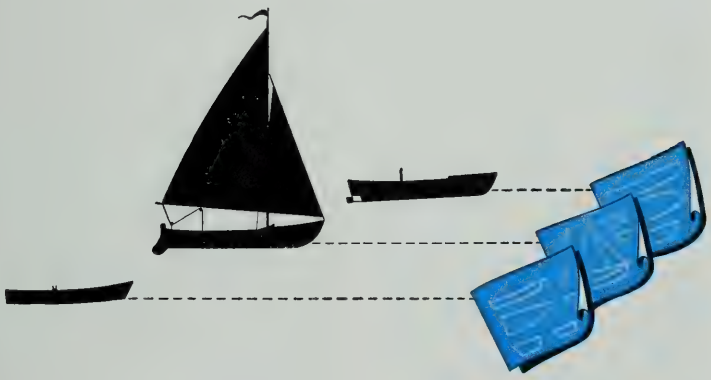
Solder Holds Bolts Tightly

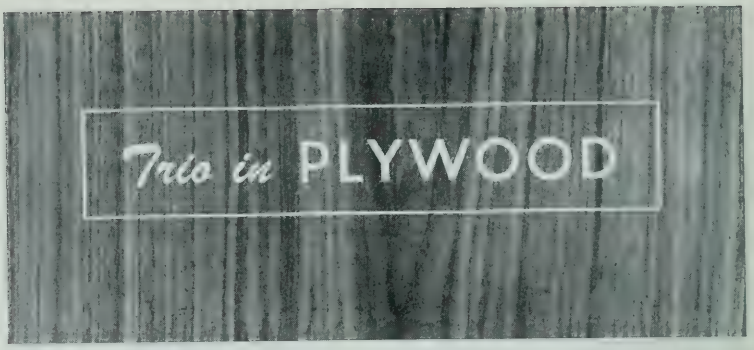
When bolts or screws are used in boatbuilding or wharf construction where lock washers are impractical to keep them from loosening, dip the threaded portion in a suitable flux, and then into molten solder. A good example of using this method is in a mounting for a mooring ring which is held in place with a screw, the threaded end of which turns into a tapped metal insert. The coating of solder on the screw threads will prevent the screw from loosening.

¶A serviceable shoulder pad for carrying a canoe or small boat can be made from an old automobile tire casing.

PART 2

Trio in PLYWOOD





PLYWOOD HAS BEEN an important material in boatbuilding for years, but the all-plywood hull came into its own only during World War II. The advantages of construction with sheet plywood are now recognized by naval architects and professional boatbuilders as well as the amateur builder. Plywood craft are always lighter and sometimes stronger than boats of the same size built of other materials. The amateur finds sheet plywood an easy material with which to work because the panels cover large areas and tedious calking is almost entirely eliminated. No complicated table of offsets is necessary. Plywood boats, properly constructed, are tight and dry—there are no seams to open with the swelling and shrinking of narrow planks. For all ordinary purposes, plywood is puncture-proof. If a hole is driven into a plywood hull, repairs can be made easily and quickly without removing a single plank.

Improper construction of a plywood boat, or use of sheet plywood on a boat not designed for this material, can result in a dismal failure—a boat that will spring, leak and break up quickly. Realizing this, the Douglas Fir Plywood Association of Tacoma, Wash., representing manufacturers of Douglas-fir plywood in the United States, conducted a special study of the sheet-plywood boat. The association secured the services of noted small-boat designers to create craft especially suited to this plywood construction. The three boats featured on following pages—"Handy," an 11-ft. 6-in. skiff; "Sport," a 13½-ft. V-bottom inboard, and "Tramp," a 15-ft. sailing knockabout — were designed by Edwin Monk, a naval architect. Mr. Monk's directions, while detailed, are intended for those with some previous experience in boatbuilding. If you are building a boat for the first time, you will be wise to first read Part 9, "Build Your Boat Right," beginning on page 161; fundamentals are treated here.

There are two chief precautions to observe when building a sheet-plywood boat —first, choice of the material, and second, choice of the boat plan. It is recommended that only exterior-type-plywood panels be used for boats, no matter whether the plywood is to go inside or outside the craft. The panels that make up exterior-type Douglas-fir plywood are bonded together with completely waterproof adhesives, thus insuring a bond that will withstand wind and weather. The grade-trademark EXT-DFPA on the panel edge is positive identification of exterior-type Douglas-fir plywood.

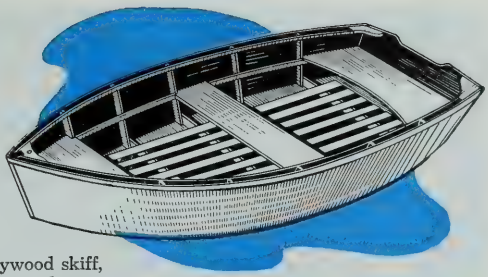
The second precaution is not to try to plank with plywood a hull designed for other material such as narrow lumber. Beautiful, modern and sturdy pleasure boats of all sizes can be built of sheet plywood, but in every instance the design must be expressly for this type of plywood. Plywood hull designs employ what are termed "developable surfaces." This means that any curve called for by the architect is within the limits to which plywood may be safely and readily bent.

Your local lumber dealer will help you in obtaining plywood panels of the most economical sheet size. Generally the most popular size is the 4 x 8-ft. panel. There are oversize sheets available as long as 50 ft. and as wide as 8 ft.

The most popular thicknesses of panels for plywood boat hulls are from ½ to ¾ in. Thicker panels are available but are rarely necessary for small boats.

Most amateur boatbuilders, when considering a specific plan, want to know the approximate weight of the finished boat. This can be figured by the following formula: plywood panels ¼ in. thick weigh .79 pound per sq. ft.; ⅜-in. panels weigh 1.125 pounds per sq. ft., and panels ¾ in. thick weigh 2.225 pounds per sq. ft.

"Handy" 11-ft. 6-in. Skiff



"HANDY," the 11-ft. 6-in. plywood skiff, is ideal for all types of rugged rowboating. Construction plans for the skiff are shown on the following page, and a material list will be found on page 33.

In case 12-ft. sheets cannot be obtained for the sides and bottom, the standard 4 x 8 sheets may be used and spliced with a butt strap as shown in the side-piece layout at Fig. 8. The bottom should be spliced at the forward end; that is, use the 8-ft. length from the transom forward. All screws should be brass or bronze.

The stem is shaped as shown in Fig. 1 and beveled, Fig. 2. The ends are left square, to be cut off later when in the boat. Forms are made of any scrap material obtainable and the notches for chine pieces are cut in as shown in Fig. 6. A frame piece must be screw-fastened at each end of the transom to receive plank or side-piece fastenings. The transom shape given in Fig. 4 is for the after side of transom. Transom and frame pieces must be cut at a bevel, Fig. 3.

Since the top edges of the side pieces are straight, the edge of the plywood can be used to measure with in laying out the shape of the sides. The butt block, if used, is placed on the inside and is kept about 1½ in. up from the bottom to allow for the chine piece, Fig. 8. Coat it with casein or waterproof glue and screw-fasten from the outside through the side plank into the butt strap, using ⅝-in. No. 8 flathead wood screws and countersinking them flush. Material for the butt strap can be obtained from the forward corners of the ⅜-in. piece or the pieces ordered for the boat bottom.

We are now ready to assemble. The side pieces are covered with a layer of marine glue or thick paint and then are screw-fastened into the stem piece. Use 1-in. No. 8 wood screws spaced about 1½ in. apart and staggered. Pull the aft ends of the side pieces together, slipping in the forms as this is done. Put the transom in place last because it may need a little fitting. Place candle wicking or a light thread of calking cotton and heavy paint or glue along the transom edges and screw-fasten to frame.

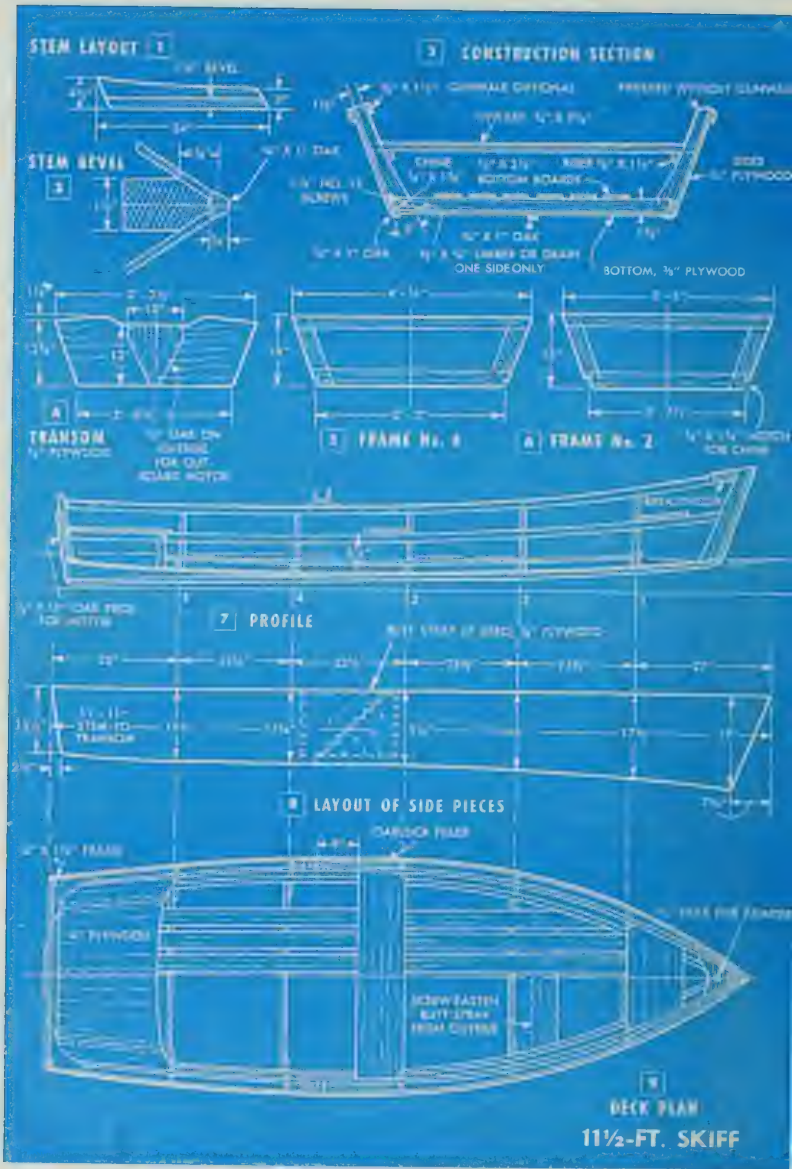
The chines are now slipped in and fastened to the side pieces, using 1-in. No. 8 screws spaced on about 2-in. centers, with marine glue or thick paint between. These pieces butt against the stem sides. Bevel the chines before fastening or let them protrude about ¼ in. beyond the side plank and bevel them later when in place.

The boat is now ready to be framed. The edges of the side pieces and chines are trimmed up and the frame-bottom pieces fitted at the different stations. With these in place the side frames can be beveled and fitted. The entire frame may be removed and fastened together on the bench or in the boat, as the builder elects. First fit in frames 1, 3 and 5 and place a brace across the top of each. The forms are then removed and frames fitted.

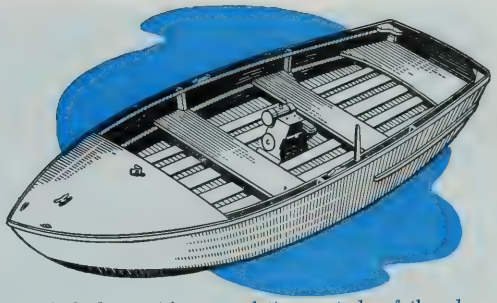
While the hull is upside down, the bottom should be fastened into place. This is cut carefully to shape from either a single sheet of plywood or from two sheets held together by a butt strap. If a butt strap is used, it can be made from the 10-in. piece which will be left over from one of the bottom panels. Use ¾-in. No. 8 screws and fasten as recommended for the side-plank butt strap. Put a thread of cotton or candle wicking and thick paint or glue between the bottom and chine piece and fasten into chine and transom with ¼-in. No. 10 wood screws spaced about 2¼ in. on centers.

Now turn the boat right side up and install the seat risers, which are then followed by the seats. See Figs. 3 and 9. The aft seat can be made from pieces left over from the side panels.

The remainder of the job needs little explanation. The chafing strips start at the stem and end about two feet from the transom. Be sure to cut the stem off flush with the breasthook (see upper right detail of Fig. 7). Also paint the inside of the boat before floor boards and aft seat are permanently placed, Fig. 9. As a final construction step, fit and fasten the guards before putting on the gunwales. Guards should be screw-fastened from the inside through the side plank, using ¾-in. No. 8 screws.


1 STEM LAYOUT
STEM BEVEL
2 CONSTRUCTION SECTION
ONE SIDE ONLY
BOTTOM, ⅜" PLYWOOD
TRANSOM
3 FRAME No. 1
4 FRAME No. 2
7 PROFILE
8 LAYOUT OF SIDE PIECES
9 DECK PLAN
11½-FT. SKIFF

"Sport" V-Bottom Inboard



"SPORT" is a V-bottomed inboard ideally designed for fishing on bays, lakes or streams. The boat is relatively fast and holds four persons comfortably.

Panels 14 ft. long will cover the bottom and sides from stem to transom. However, if the 14-ft. lengths are not immediately available at local lumber dealers, shorter panels may be used and spliced as shown in the butt-strap detail, Fig. 10. The splices in bottom and side planking, if required, should be made toward the stern, that is, use the 8-ft. length from the stem aft.

Fastenings, marine glue and fittings can be purchased either from lumber dealers or the marine-goods stores. For fastening the plywood planking, use 1-in. No. 8 flathead screws, brass or galvanized. Guard strips are fastened with 1½-in. No. 10 screws.

For good construction, planking fastenings should be spaced not more than 2 in. or 2½ in. apart along all plywood joints and should be staggered. Plywood is fastened to the frames with screws spaced not more than 4 in. apart. In fastening plywood, countersink screw holes only enough to permit drawing screw heads flush with the surface. Never pull screws below the surface of plywood.

Before beginning actual building, determine whether glue or calking is to be used at joints. Many builders employing plywood planking prefer to use glued-up construction throughout—both at joints and all other contact surfaces—and eliminate all calking. If so, make sure a waterproof marine glue is used and follow closely directions of the manufacturer in applying the glue. Use care in fitting all joints well and securing planking before glue sets. If the joints are to be calked, leave them slightly open on the outside and calk after fastening.

To assure a perfect seal of the joint between the planking and transom, and between the bottom planking and chine, lay a strip of outing flannel or candle wicking between the surfaces. The flannel or wicking should be well-soaked in marine glue or white lead and oil before it is laid in.

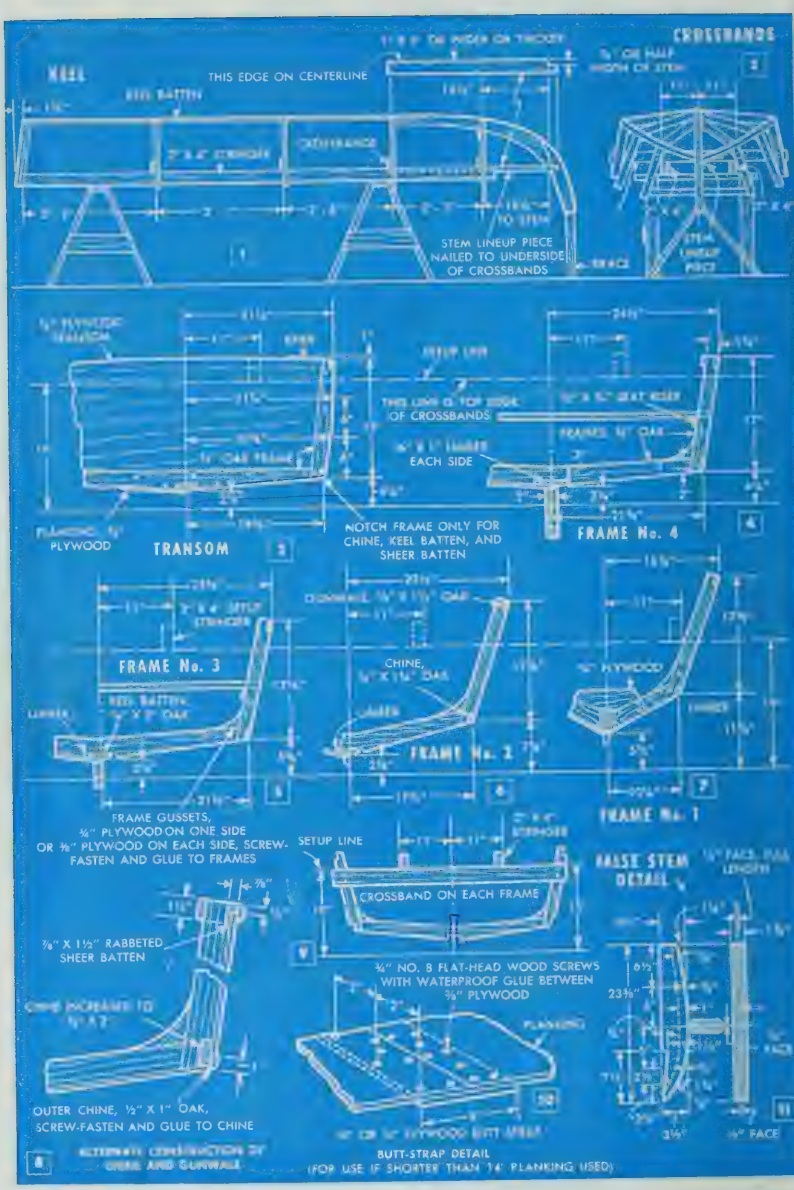
After completing a study of the plans, shown on following pages, and the material list, on page 33, lay out a full-size plan of each frame on a piece of plywood. The back of the plywood panel to be used for the deck will serve this purpose. Lay out each frame from the center and base lines, numbering each to avoid confusing lines. Also lay out full-size plans of stem and transom.

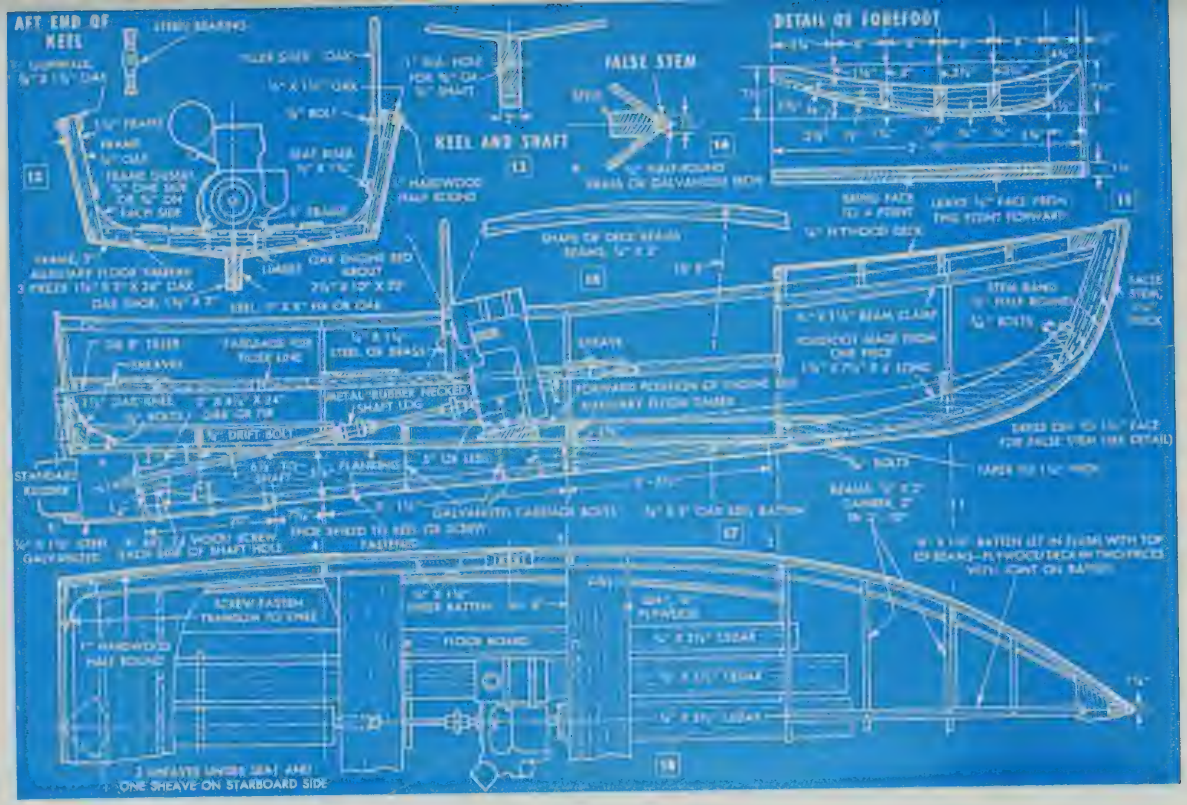
Build the frames first, Figs. 3 to 9, making each piece from the full-size layout. Butt the joints as shown on the plans and tack or clamp the pieces in position on the full-size layout before fastening on the frame gussets. Be sure to use waterproof glue between all joints. An excellent procedure is to screw-fasten the frame together, then remove the screws, spread on the glue and refasten. This prevents the parts from slipping out of place. In constructing the transom frame, Fig. 3, bear in mind that the transom is on an angle of 1¾ in. and that notches for gunwale, chine and keel battens must be laid out accordingly. Cut these notches through the frame, but not through the transom. Lay out the stem pieces carefully from the plan and full-size layout. See details of false stem, Fig. 11.

Be sure that crossbands on frames are laid out from the base line so that when the frames are placed on 2 x 4 stringers, Fig. 2, they will line up properly for height.

The next step is to fasten frames in position on 2 x 4 stringers as shown in Fig. 9. The knee securing transom to keel batten is fastened on the same way. Temporarily fasten the stem and check its angle (or bevel) for the planking by bending a strip along the frames and stem. When the stem angles are correct, fasten it permanently. Next place the chine strips and gunwale battens. These should be beveled to fit the side of stem, fastened with a screw, then bent into place and fastened securely.

In Fig. 8 is a detail for an alternate construction of the chine and gunwale. This construction is superior to the other plan in that it protects the edges of the planking, but it requires more skill. In the usual


KEEL
THIS EDGE ON CENTERLINE
KEEL BATTEN
CROSSBANDS
STEM LINEUP PIECE NAILED TO UNDERSIDE OF CROSSBANDS
TRANSOM
NOTCH FRAME ONLY FOR CHINE, KEEL BATTEN, AND SHEER BATTEN
FRAME No. 4
FRAME No. 3
CHINE, ½" X 1¼" OAK
FRAME No. 2
FRAME No. 1
FRAME GUSSETS, ¼" PLYWOOD ON ONE SIDE OR ⅜" PLYWOOD ON EACH SIDE, SCREW-FASTEN AND GLUE TO FRAMES
SETUP LINE
CROSSBAND ON EACH FRAME
⅜" X 1½" RABBETED SHEER BATTEN
¼" NO. 8 FLAT-HEAD WOOD SCREWS WITH WATERPROOF GLUE BETWEEN ⅜" PLYWOOD
OUTER CHINE, ½" X 1" OAK, SCREW-FASTEN AND GLUE TO CHINE
BUTT-STRAP DETAIL (FOR USE IF SHORTER THAN 14' PLANKING USED)
FALSE STEM DETAIL


AFT END OF KEEL
STEEL BRACING
KEEL AND SHAFT
FALSE STEM
DETAIL OF FOREFOOT
ONE SHEAVE ON STARBOARD SIDE

method, one edge of the planking can be left full to measure and planed to fit while in place. Either method is good construction.

With jack plane or jointer, dress the keel batten, frames and chine strips to the correct angle so the planking will rest on a full surface and not ride high at some points.

The frame is now ready for application of the planking. Fit the bottom planking first but do not fasten it. As it takes only two plywood panels for the entire bottom planking there will be but one joint at the chine and one at the center of the keel batten. As mentioned previously, if it is necessary to cut the bottom planking from a panel shorter than full length, work the longer piece from the bow so the butt strap occurs toward the stern where there will be little strain and no twist.

Cut the plank to measure and bend it along the bottom, clamping firmly in place. Mark the plank, carefully remove and cut to line. Use a bevel square on each frame to secure the angle of cut.

With bottom planks temporarily in place, fit the side planks by the same procedure. Then permanently fasten the side planks. Start by securing the planks to the stem first and then bending the planks in place against the frames. Watch the stem to see that it is not sprung out of shape by the first side plank applied.

Before fastening the bottom panels, cut the limbers about ⅜ in. deep x 1 in. wide (as shown in Fig. 4). The limbers are cut in frames on each side of the keel batten so that any water in the boat can run the full length and be pumped or bailed out at one place rather than stand between frames.

Now secure the bottom planks, taking care to make a good seal at this point between keel batten and planking.

After dressing the planking at stem and keel joint, the keel and shaft log should be made up, Fig. 13. The keel can be laid out from the plan, starting from the aft end. Use frame No. 4 as a positioner. The upper part of the shaft log, or deadwood as it is also called, can be cut from the piece left over from the keel. Set the keel in place on the boat and the shape can then be obtained.

Half the hole for the shaft is cut out of each piece with a gouge, or it may be cut square-cornered on a table saw. The two pieces should next be glued together. After the glue sets they are screw-fastened as shown. The piece shown cut out of the bottom of the keel aft (on profile view, Fig. 17), is to facilitate fastening. This is necessary since there is very little wood alongside the shaft hole for a through bolt.

Next, the stern bearing should be set temporarily in place and the aft end of the keel shaped to suit as shown in the separate detail of Fig. 12. You can secure the bearing in place now if you wish. The keel then should be secured on the boat, nailing or screwing it through the keel batten. Place plenty of white lead or marine glue under the keel. A long 1-in. auger or bit extension can be used to extend the shaft hole through the keel batten. If the auger or bit is not obtainable, bore the hole before fastening the keel. Place glue or white lead under the oak shoe and false stem and nail or screw-fasten them in place. The boat may now be turned over.

The three auxiliary floor timbers are fitted on alongside frame No. 3 and the others as shown in Fig. 12. In addition to the bolt through the keel, the plywood planking should be fastened to the floor timbers the same as to the frames. The engine bed also is fastened in a similar manner. Follow through with the seat risers, seats, deck beams, deck, etc., and complete the boat as shown in the half-plan, Fig. 18. Remove the crossbands and paint the boat, leaving the floor boards to the last. The little oak knees at the transom corners are optional but very good practice. They must be installed before the gunwale is fitted and the latter must be tapered at the aft end to 1½ in., the thickness of the knee.

The motor may be from 2½ to 6 hp. Motors vary in depth below the crankshaft, so this should be taken into consideration in the engine bed. As shown in Fig. 17 this depth can be 5 in. or less. For a greater depth the motor can be moved forward and for an extremely deep motor the shaft line must be raised. The seat also can be shifted forward at frame No. 4 for additional room.

The metal shaft log and stern bearing are standard marine articles, as are the rudder, skeg, etc.

In lining up the motor, it is best to first install the stern bearing, centering the shaft at both ends of the hole. With the coupling in place on motor and shaft, the motor can be raised or lowered and shifted until the coupling faces fit all around. A feeler gauge is a great help here.

The shaft log should next be fitted to the keel behind a gasket of light canvas soaked in paint. A wedge-shaped shim may be required if the angle is not correct. Be careful to make this a watertight connection.

The steering arrangement shown in Fig. 17 is optional. A wheel may be substituted for the stick and may be placed at the forward end of the boat if desired.

A few words of caution. Do not cut the tiller hole through the transom any larger than necessary. Take into consideration the depth of a motor before purchasing it. Until the hull is planked, constant care should be taken to see that the boat is not pulled out of shape by stresses put on it in bending the various members into place.

"Tramp" - - 15-ft. Sailing Knockabout

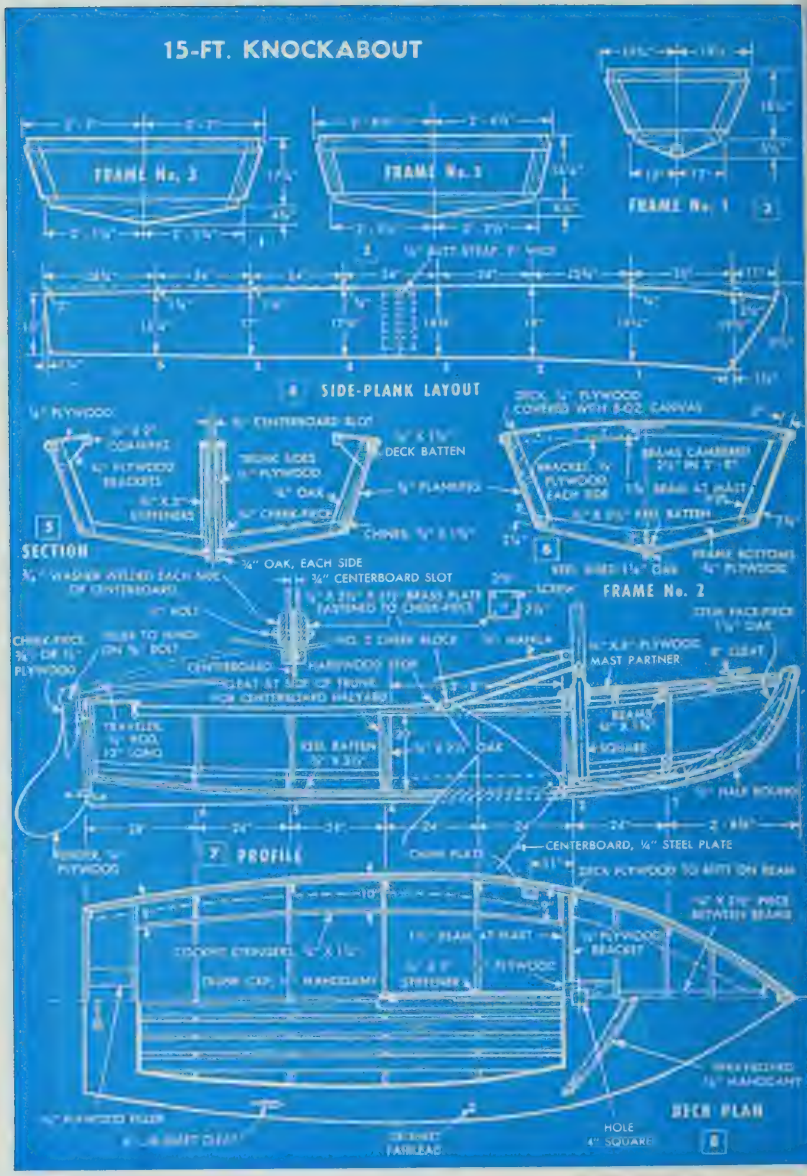
ANY SAILBOAT fancier will like "Tramp," the trim, 15-ft. knockabout that's so easy to build in plywood.

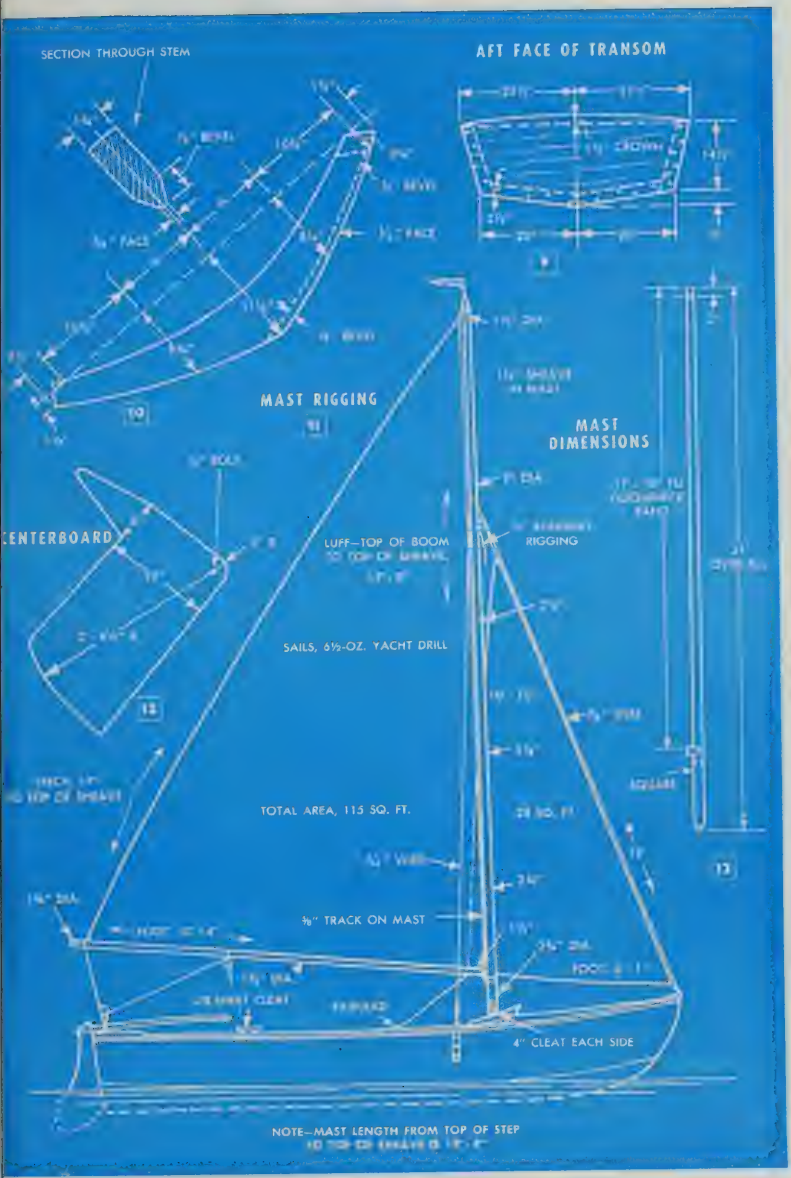
The first operation is to cut the stem, transom and side planks and assemble the forms, Figs. 1 to 6. Use casein or waterproof glue under the butt strap joining the side planks together. Screw-fasten them, using ¾-in. heavy-bodied wood screws of a size not less than No. 10. Allow 24 hours for the lap to dry. The stem is beveled as shown in Fig. 10. The bevel stops just at the sheer line. Forms can be made of almost any scrap material on hand. If you are a good enough mechanic, they can be dispensed with and correctly beveled frames made to their exact shape can be placed permanently in the boat. Screw-fasten the ¾-in. oak frame (shown as dotted lines in Fig. 9) at sides and bottom on the inside of the transom. Then notch out the bottom of the frame to receive the keel batten. Make this a snug fit.

Side planks must then be screw-fastened to the stem and the aft ends pulled together, the forms being slipped into place as this is being done. The transom is placed last and must be beveled so that the side planks fit tightly against the cleats and the transom edge. Be sure to place white lead and a thin thread of cotton between planks and stem and transom prior to joining them together. Also, in any phase of construction where more than two pieces are joined and watertightness is required, this same procedure should be followed. The stem will fit into the notch in frame No. 1 in such a manner that enough wood is left to bevel the stem bottom off fair with the frame. It is best to fasten stem to side pieces rather temporarily as it may be necessary to loosen the screws and adjust the stem so that it fairs properly into frame No. 1. The assembling is easiest with the boat upside down.

Chines are next and should be screw-fastened from the outside, using 1-in. No. 8 brass wood screws about 3 in. apart. Apply paint between the side pieces and chine. Deck battens follow in a similar manner.

A batten is now bent along the bottom at centerline. With this in place, the shape of the frame bottoms is obtained. Tack these in place at frames 2, 4 and 6 and then fit and bevel the side pieces. The frame should now


15-FT. KNOCKABOUT
FRAME No. 3
FRAME No. 2
FRAME No. 1
4 SIDE-PLANK LAYOUT
5 SECTION
FRAME No. 2
7 PROFILE
DECK PLAN


SECTION THROUGH STEM
AFT FACE OF TRANSOM
MAST RIGGING
MAST DIMENSIONS
CENTERBOARD
LUFF—TOP OF BOOM
RIGGING
SAILS, 6½-OZ. YACHT DRILL
TOTAL AREA, 115 SQ. FT.
⅜" TRACK ON MAST
4" CLEAT EACH SIDE
NOTE—MAST LENGTH FROM TOP OF STEP

be removed from the boat and fastened together using 1½-in. wood screws. A beam can be sawed to shape with a camber of 2¼ in. in 5 ft. 8 in., and used as a pattern for the plywood brackets. These are cut to the camber of the deck and attached to frame No. 2 before placing it in the boat. Next place a brace across the tops of frames 4 and 6. When these are in place remove the forms and replace with frames. Cut out the frames for the keel batten before placing them, since this is much easier to do on the bench.

The keel batten is our next step. The forward end is placed into the stem. The ¾-in. slot for the centerboard should be cut first, leaving a little wood at each end of the slot to be cut out later. The centerboard trunk should be made up, placing heavy white lead between the plywood and the end pieces. Fasten the plywood to the ¾-in. cheek-pieces and the trunk stiffeners before assembling. Use 1-in. screws through the plywood into the oak. Frame No. 3 will have to be cut in two, cutting out a slot 1¾ in. wide. The centerboard trunk must fit tightly against the keel batten and is fastened through the batten into the cheek-pieces with 1½-in. screws. Here, too, put white lead and cotton in the joint. Drill a hole for the ½-in. centerboard bolt, 3½ in. in from the end and 1¼ in. up from the bottom of trunk, and insert the bolt.

We are now ready for the bottom. With the aid of a batten as a guide, take a plane and trim up frames, chines, stem, etc. Put on the forward pieces first, beginning at the stem and using a ½-in.-plywood butt strap as was done with the side pieces. Fasten bottom into chines and keel batten with 1-in. No. 8 screws about 2½ in. apart. Don't forget the white lead and calking cotton. Pack calking well around the centerboard trunk and also tuck it in securely at the frames.

The balance of the job needs but little explanation as it is just a matter of fitting the parts in place, Figs. 7 and 8. Put in the deck beams, fastening their ends well into frames 1 and 2 and install the plywood brackets. A piece of scrap should be fastened inside the side plank opposite the chain plates. Fillers should be placed for jib-sheet cleat, traveler, and fairleads before putting on the deck. Paint the plywood well before stretching on the canvas. This should be stretched as tightly as possible and fastened around the edges under the half-round with galvanized tacks.

The mast and rigging, Figs. 12 and 13, can be erected in several ways. Loops may be spaced around the mast or socket fittings may be attached to wire and in turn to metal strips or tangs screwed and bolted to the mast. One-eighth-in. aircraft strand may be substituted for the 3/16-in. wire shown. If the builder is not familiar with the rigging of small boats, see the section on "Mast, boom and fittings" on page 174.

The mainsail can be lashed to the boom, but slides and a track are handier, though a little more expensive. A wood pattern should be made for the centerboard, Fig. 12, and tested to make sure it can be pulled all the way up. Then the steel centerboard is cut and mounted. The centerboard rope belays to a cleat at the side of the centerboard trunk.

Fittings for hanging the rudder can be obtained at a marine-hardware store, as also can the gooseneck.

MATERIAL LIST FOR KNOCKABOUT

1 piece oak or mahogany, 1¾ x 11¼ in. x 4 ft.—for stem
1 piece oak or other hardwood, 1¼ x 4 in. x 5 ft.—for stem face piece
1 piece oak or other hardwood, 1 x 6 in. x 6½ ft.—for skeg
1 piece oak, ¾ x 3½ in. x 13 ft.—for keel batten
32 pieces oak, ¾ x 3 in. x diagram—for side frames and trunk ends
4 pieces oak, ¾ x 1¾ in. x 16 ft.—for chines and deck batten
2 pieces mahogany, 1 in. half round x 16 ft.—for guards
2 pieces fir, spruce, ¾ x 1¾ in. x 10 ft.—for cockpit stringers
1 piece fir, spruce, ¾ x 12 in. x 6 ft.—for beams
1 piece fir, spruce, 1¾ x 5½ in. x 5 ft.—for beams
2 pieces exterior fir plywood, ⅜ x 48 in. x 8 ft.—for side planking
2 pieces exterior fir plywood, ⅜ x 48 in. x 8 ft.—for bottom planking
1 piece exterior fir plywood, ½ x 48 x 50 in.—for centerboard trunk
1 piece exterior fir plywood, ¾ x 48 in. x 4 ft.—for transom, rudder and brackets
1 piece exterior fir plywood, ¼ x 48 in. x 8 ft.—for deck
1 piece exterior fir plywood, ¼ x 48 in. x 4 ft.—for deck
8 pieces cedar, spruce, fir, ½ x 3½ in. x 10½ ft.—for floor boards
2 pieces mahogany, ½ x 2 in. x 9 ft.—for coaming
1 piece mahogany, ½ x 6 in. x 4 ft.—for cockpit ends
1 piece mahogany, ½ x 4 in. x 6 ft.—for sprayboards
1 piece oak or hickory, 1 x 3 in. x 4 ft.—for tiller
1 piece spruce, 3 x 3 in. x 21 ft.—for mast
1 piece spruce, 2 x 2 in. x 11 ft.—for boom
1 piece fir or pine, ¾ x 6 in. x 12 ft.—for forms
3 pieces fir or pine, ¾ x 3½ in. x 8 ft.—for forms
2 pieces oak, ¾ x 4 in. x 4 ft.—for trunk cheek-pieces

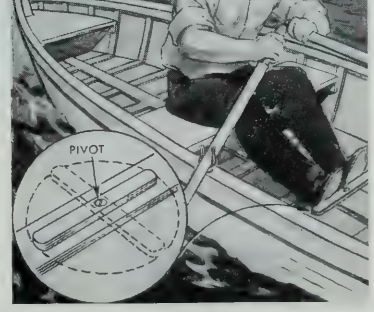
MATERIAL LIST FOR INBOARD

1 piece oak or fir, 2 x 7 in. x 8 ft.—for keel and deadwood
1 piece oak, 1⅜ x 2 in. x 9 ft.—for shoe
1 piece oak, ¾ x 3 in. x 10 ft.—for keel batten
2 pieces oak, ¾ x 1¾ in. x 13 ft.—for chines
2 pieces oak, ½ x 1½ in. x 14 ft.—for sheer batten
2 pieces oak, ½ x 1¾ in. x 9 ft.—for seat risers
2 pieces oak or fir, ¾ x 1½ in. x 5 ft.—for beam clamp
2 pieces oak, ¾ x 8 in. x 10 ft.—for frame bottoms
2 pieces oak, ¾ x 4 in. x 10 ft.—for frame sides
1 piece exterior-type plywood, ⅜ x 48 in. x 14 ft. or
1 piece exterior-type plywood, ⅜ x 48 in. x 8 ft. and
1 piece exterior-type plywood, ⅜ x 48 in. x 6 ft.—for bottom planking
1 piece exterior-type plywood, ⅜ x 48 in. x 14 ft. or
1 piece exterior-type plywood, ⅜ x 48 in. x 8 ft. and
1 piece exterior-type plywood, ⅜ x 48 in. x 6 ft.—for side planking
1 piece oak, 2½ x 10 x 20 in.—for engine bed
1 piece exterior-type plywood, ¾ x 48 in. x 5 ft.—for transom seats and frame gussets
1 piece exterior-type plywood, ½ x 21 in. x 4 ft.—for transom seat
1 piece fir or pine, ¾ x 1¾ in. x 8 ft.—for transom-seat support
1 piece exterior-type plywood, ¼ x 24 in. x 6 ft.—for deck
1 piece oak, ½ x 3½ in. x 3 ft.—for transom motor stiffeners
1 piece spruce, oak or fir, ¾ x 12 in. x 4 ft.—for beams
1 piece spruce, oak or fir, 2½ x 6 in. x 1 ft.—for breasthook
1 piece oak, 1¾ x 4 in. x 2 ft.—for stem
1 piece oak, 1¾ x 7½ in. x 4 ft.—for forefoot
2 pieces oak, ⅝ x 1 in. x 9 ft.—for guards
1 piece oak, 1¼ x 6 in. x 4 ft.—for false stem and forefoot
2 pieces cedar or pine, ¾ x 3½ in. x 9 ft.—for floor boards
3 pieces cedar or pine, ¾ x 5½ in. x 10 ft.—for floor boards
2 pieces fir or pine, 2 x 4 in. x 12 ft.—for set-up stringers
1 piece fir or pine, 1 x 4 in. x 14 ft.—for crossbands
1 piece fir or pine, 1 x 3 in. x 6 ft.—for braces
2 pieces oak, ⅝ x 1¾ in. x 10 ft.—for gunwale
1 piece oak, 1½ x 4 in. x 2 ft.—for knees

MATERIAL LIST FOR SKIFF

1 piece exterior fir plywood, ¼ x 48 in. x 12 ft.—for sides
1 piece exterior fir plywood, ⅜ x 48 in. x 12 ft.—for bottom
1 piece exterior fir plywood, ¾ x 15 x 40 in.—for transom
1 piece exterior fir plywood, ¾ x 15 x 24 in.—for forward seat
15 lineal ft. spruce or oak, ¾ x 3 in.—for frame sides
18 lineal ft. spruce or oak, ¾ x 1¾ in.—for frame bottoms
2 pieces spruce or oak, ¾ x 1¾ in. x 12 ft.—for chine
6 pieces spruce, oak or fir, ⅝ x 1½ in. x 12 ft.—for gunwale, guard and riser
6 pieces cedar, spruce or fir, ½ x 3½ in. x 8 ft.—for floor boards
1 piece cedar or spruce, ¾ x 9½ in. x 4 ft.—for thwart
1 piece oak, 1¾ x 4½ x 24 in.—for stem
1 piece fir or spruce, 1 x 3½ in. x 4 ft.—for skeg
1 piece oak, ¾ x 1 in. x 11 ft.—for keel
2 pieces oak, ½ x 1 in. x 10 ft.—for chafe strips
1 piece oak, 1½ x 6 in. x 3 ft.—for breasthook and knees
1 piece oak, ½ x 10 x 15 in.—for outboard pad
20 pieces fir, pine or scrap, ¾ x 2½ x 3 in.—for forms

Pivoted Footrest in Boat Swings Out of the Way for Bailing



Footrests usually are attached so that they are in the way when scrubbing or bailing out a boat. If the rest is pivoted, it may be turned out of the way when not in use. The pivot bolt should be tight enough to hold the rest in closed position.

Let the Wind "Row" Your Boat

ONCE this detachable keel is installed on your rowboat and locked in place with the camming arrangement shown you not only can run free before the wind with a suitable sail but you also can do systematic tacking in any safe sailing waters. For fishing or other uses where the rowboat's shallow draft is necessary or desirable, simply unclamp the keel assembly and slide it over the stern, then unstep the mast and there you are, ready for the oars again. Only general dimensions are given in the details, Figs. 1 to 5 inclusive, as the clamping yoke and saddle arrangement must be made to fit the boat at hand. The halves of the saddle are shaped to fit the curves of the hull near the midship section and the top ends of the halves are offset slightly as shown to clear the gunwales. After bending to shape, the parts are riveted to the keel as in Fig. 3. Projecting "ears" or pads also are riveted to the ends of the keel, Fig. 4, to give a more rigid bearing. Of course you must have a rudder, Fig. 1, and, if attaching the keel to a canoe, you will need the rudder board, Fig. 2. Usually the front seat can be utilized as a mast step where indicated in Fig. 5. Only one method of rigging the sail is shown. There are, naturally, other sailing rigs which are equally simple and safe.

PART 3

"Sea Craft" -- a 25-foot Cabin Cruiser

How to Build "SEA CRAFT"—a 25-ft.

IDEAL for use on large lakes or rivers, and fully seaworthy for offshore ocean cruising, "Sea Craft" is a smart cabin cruiser designed with an eye toward simple, low-cost construction for the inexperienced boatbuilder. During World War II, the original boat was given severe tests for seaworthiness when it was used by the United States Coast Guard to take high-ranking officers from ship to shore. The boat has an over-all length of 24 ft., 7⅝ in., and a breadth at sheer of 7 ft., 8¾ in. A converted Chrysler "75" auto engine easily pushed it along at a cruising speed of 15 knots. However, any marine or converted auto engine of similar horsepower may be used.

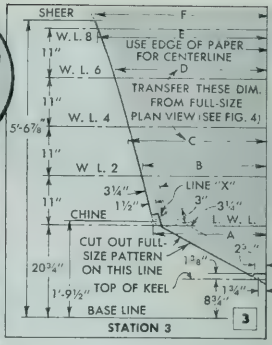
Although this section describes the building of a sedan cruiser, this particular hull, with a few changes in the cabin construction, is readily adaptable to a sport fisher, express cruiser or utility boat. The cabin design of Sea Craft was selected because it offers one of the best all-around accommodations. Its open cockpit is large enough for fishing, lounging or sun bathing and the roomy cabin provides comfortable living quarters on a long cruise. It is equipped with a fresh-water tank, sink, cooking stove, toilet and two bunks. Two additional upper bunks can be fitted to sleep a total of four. In addition, there is plenty of cabinet and stowage space for gear. The photo, Fig. 1, shows the cabin interior looking forward.

Laying out, cutting and assembling the keel and rib structure is by far the most important operation of building the boat. As this framework is the backbone of the entire boat, the performance and beauty of the craft will depend upon the accuracy and skill with which the framework is constructed. As previously mentioned, the type of cabin, engine and even decking can be changed to suit the individual builder's fancy, but no changes should be made in the hull if the proven performance of this cruiser is to be maintained.

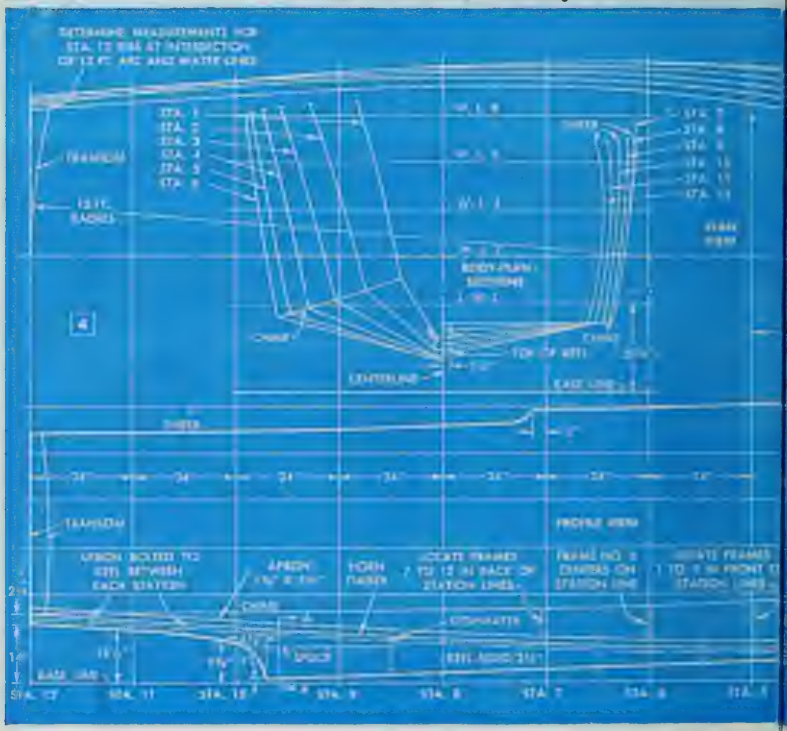
The first step in building a boat of this size is lofting, that is, drawing the profile, the plan view and the body-plan views full-size on paper, as shown in Fig. 4. These drawings are cut out to serve as patterns for marking and assembling the hull frame. Full-size, cutout patterns of the keel and ribs are available to those who care to purchase them. If you intend to make your own patterns, get a roll of heavy wrapping paper and edge-lap and glue enough strips together to make up the required width for the height from the base line to the top of the stem shown in the profile view, Fig. 4. The paper is tacked down on a wooden platform—a

Cabin Cruiser

Large roomy cabin with sleeping accommodations and galley provides comfortable quarters on long cruises

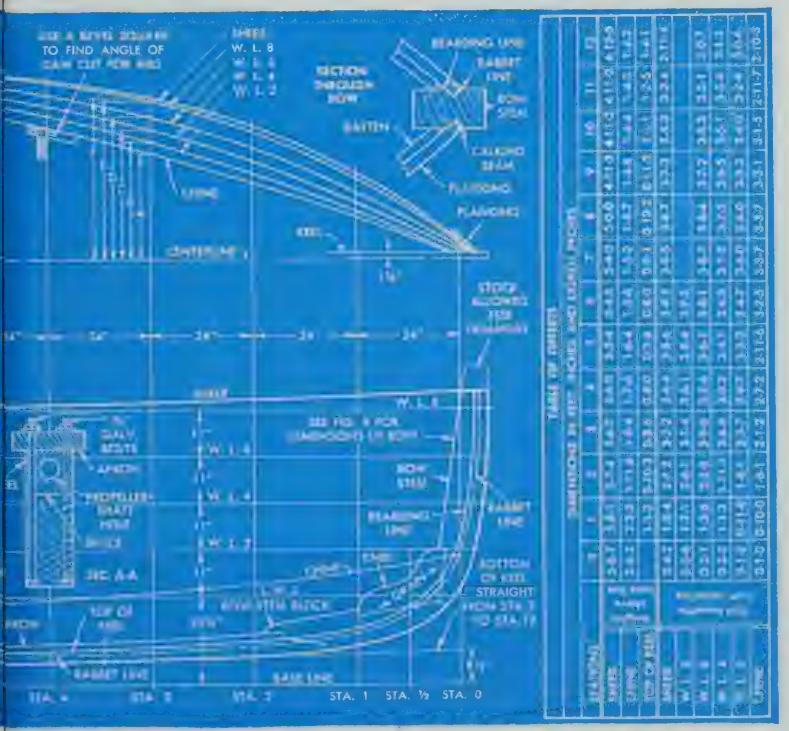


Above, full-size half pattern of each station is drawn on heavy paper. Left, the natural curve of a wooden batten is used to mark curved line connecting half-breadth dimensions



floored attic is an excellent place—and the profile view is drawn first. With a long straightedge or chalk line, lay down the base line, load water line (L.W.L.) and water lines (W.L.) from the dimensions given in Fig. 4. Then mark off the station points from 0 to 12, spacing them 24 in. apart along the base line.

In the table of offsets at the right in Fig. 4, refer to the column which reads "top of keel." Note that station 0 is blank because at this point the top of keel runs into the bow stem. At station 2 the top of keel is the bearding line. Station 3 reads 0-8-6 which means the top of the keel is 8¾ in. above the base line at this point. All figures in the table of offsets are in feet, inches and eighth inches. For example, the 6 for station 3 indicates ⅝ in., or ¾ in. Measure this distance from the base line along the No. 3 station line and mark it. Follow this procedure at all station lines, marking each top-of-keel point. Drive a small nail through the paper into the floor at each mark and bend a ¾ x 1-in. batten against the nails. It will be necessary to place nails on both sides of the batten at some stations to hold it in place. The batten should be straight-grained wood that will bend easily without any irregularity in the curve it takes. It should be somewhat longer than the length of the boat as it will be used later to fair the sheer, chine and water lines in the plan view. When the batten is in position, transfer its curvature to the paper by drawing a line along it. This is the shape of the top of the keel. The bottom of the keel is straight. Measure 8½ in. above the base line at station 0 and 1 in. above the base line 6½ in. forward of station 10. Then connect the two points with a line drawn along a straightedge or snap a chalk line. The sharp curve at the aft end of the keel can be drawn freehand or with a French curve. The chine and sheer lines are drawn in by the same method used in plotting the top-of-keel line. To draw in the bow stem, knee and



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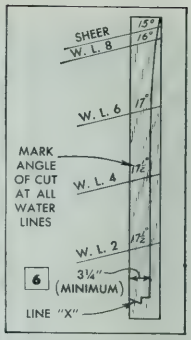


Angles of saw cut marked on ribs, above, are called off by bandsawyer, left, as a helper tilts table

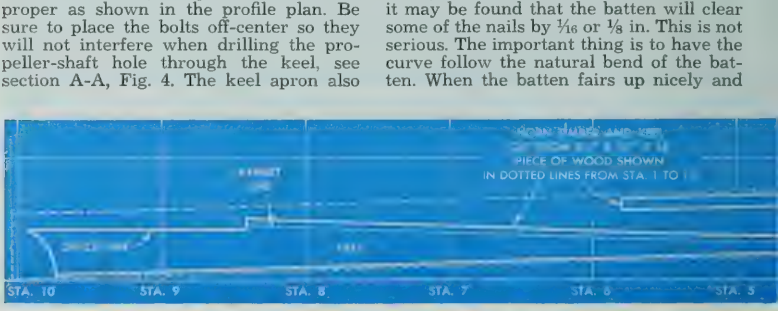
bow-stem block, follow the dimensions given in Fig. 9. Use a light, flexible batten to fair in the curves. Carefully mark the rabbet and bearding lines, as these must be transferred to the bow-stem pieces after they are assembled.

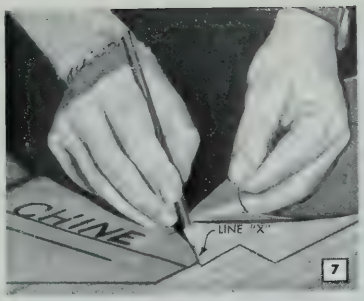
To transfer the lines to the wood, cut the paper along the bottom of the keel and forward edge of the bow stem. Do not cut the other lines as the pattern will be used later to lay in the propeller-shaft angle and motor mounts. The uncut lines can be transferred to the wood by rubbing the underside of the paper with a soft pencil and then tracing over the lines in a manner similar to that of using carbon paper. However, no cutting should be done until all other patterns have been made.

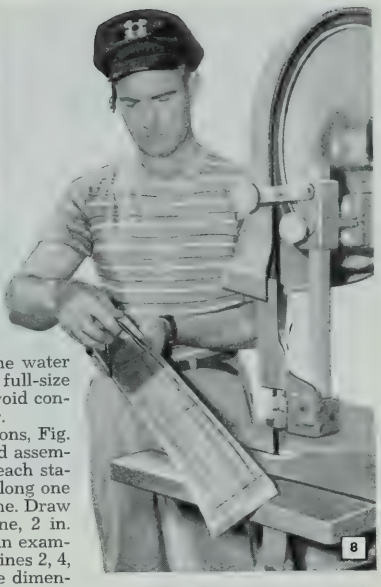
The keel is made of oak, apitong or straight-grained Douglas fir, and is assembled in two pieces cut from a single piece of timber as indicated by the dotted lines in Fig. 9. The aft section, known as the horn timber, is spliced to the keel proper as shown in the profile plan. Be sure to place the bolts off-center so they will not interfere when drilling the propeller-shaft hole through the keel, see section A-A, Fig. 4. The keel apron also should be oak, apitong or Douglas fir, 1⅜ in. x 5½ in., and extends from the bow-stem block to the transom. Bolt the apron to the keel between the stations. The dot-dash lines through the bow-stem parts in Fig. 9 indicate where to bolt them together.

A plan view, as shown in Fig. 4, must be drawn full-size in the same manner as the profile view. First, lay down the centerline and then draw perpendicular lines across the paper at each station point. These station lines should be labeled clearly. Refer to the table of offsets in the chine column of the "half-breadths from centerline," and measure off the distance given from the centerline.

For example, read across the chine column under station 3, measure off the distance 2-1-2, which is 2 ft., 1¼ in., and mark the spot. This is shown as dimension A in Fig. 4. Then drive a small nail at the mark. Follow this same procedure at each station for the chine, and bend the long batten against the nails. When fairing the line, it may be found that the batten will clear some of the nails by 1/16 or ⅛ in. This is not serious. The important thing is to have the curve follow the natural bend of the batten. When the batten fairs up nicely and





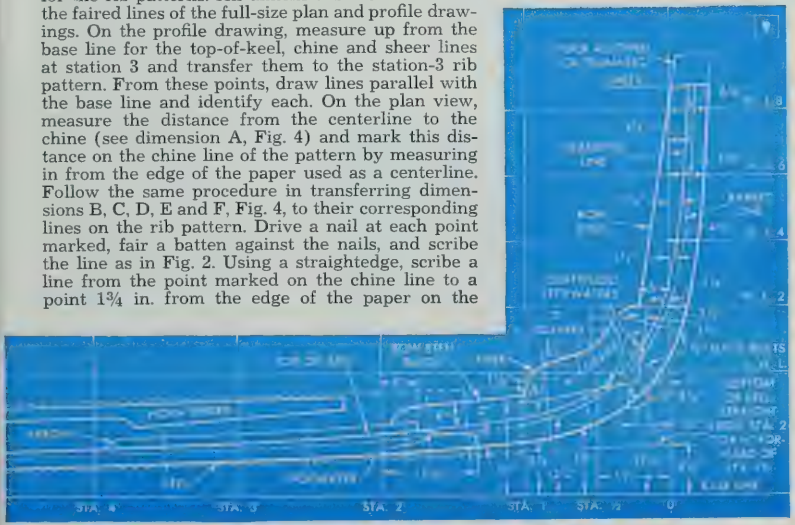


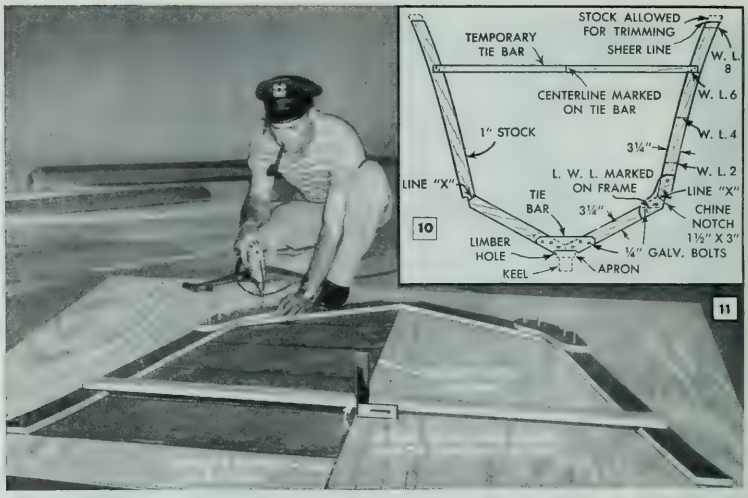
A compass or marking gauge set at 3¼ in. is used to scribe a line conforming to the contour of the outside edge of rib. This becomes the inside edge of the rib

has a smooth, flowing curve, which you can see by sighting with your eye, draw in the line. Use the same method for all the water lines and the sheer line until you have a full-size drawing of the plan view as in Fig. 4. To avoid confusion later, draw each line a different color.

Full-size drawings of the body-plan sections, Fig. 4, become patterns for marking the ribs and assembling the frames. Cut a piece of paper for each station. The paper must be perfectly straight along one of the long sides which is used as a centerline. Draw a base line at right angles to the centerline, 2 in. from the bottom edge. Taking station 3 as an example, draw in the load water line and water lines 2, 4, 6 and 8 parallel with the base line from the dimensions given in Fig. 3. These lines are spaced the same for all stations. Identify each line.

The table of offsets is not used to draw in the lines for the rib patterns. All dimensions are taken from the faired lines of the full-size plan and profile drawings. On the profile drawing, measure up from the base line for the top-of-keel, chine and sheer lines at station 3 and transfer them to the station-3 rib pattern. From these points, draw lines parallel with the base line and identify each. On the plan view, measure the distance from the centerline to the chine (see dimension A, Fig. 4) and mark this distance on the chine line of the pattern by measuring in from the edge of the paper used as a centerline. Follow the same procedure in transferring dimensions B, C, D, E and F, Fig. 4, to their corresponding lines on the rib pattern. Drive a nail at each point marked, fair a batten against the nails, and scribe the line as in Fig. 2. Using a straightedge, scribe a line from the point marked on the chine line to a point 1¾ in. from the edge of the paper on the





Ribs, gussets and tie bars are assembled directly over full-size patterns to assure exact alignment. Builder is shown drilling bolt holes through gussets and ribs. Note how centerline is marked on temporary tie bar

top-of-keel line. Dimensions for the notch over the keel apron and limber holes, indicated in Fig. 10, are given in Fig. 3 above the top-of-keel line. These dimensions apply to all stations except stations 1 and 2, which are slightly narrower because the apron tapers to 3½ in. where it joins the bow-stem block.

To draw in the notch for the chine batten, draw a line parallel with and 1½ in. from the faired line at the chine end. Measure 3 in. along this line from where it intersects the straight line from the chine to top-of-keel. All chine notches are made the same way with the exception of station 1, shown in the inset of Fig. 2. Line X, Fig. 3, indicates where the two ribs join and is located by scribing a line from the point of intersection of the straight and faired lines to the point of intersection of two lines drawn parallel with and 3¼ in. from the straight and faired lines. Cut out the pattern as indicated by the shaded area in Fig. 3, allowing it to extend about an inch beyond the sheer line for trim. Also, make a cut on line X to mark the ends of the ribs as shown in Fig. 7. All rib patterns are drawn and cut out as previously described, except station 12 for which the following method is used: On the full-size plan view strike a 12-ft. arc extending across the chine, sheer and water lines with a string centered at station 6. To determine the half-breadth dimensions for station 12, or the transom, measure the distance from the centerline to where the arc crosses the water lines.

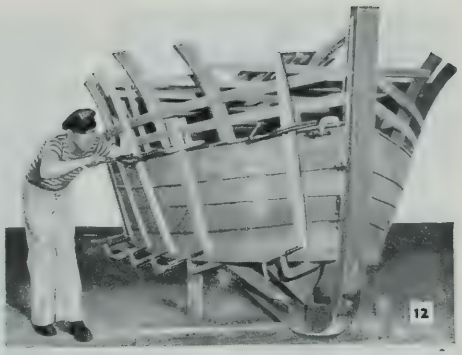
Use oak, apitong or vertical-grained Douglas fir, 1-in. thick, for rib stock. Each frame, with the exception of station 1, has four ribs held together with gussets and tie bars as shown in Fig. 10. Station 1, being narrower, requires only one rib on each side. Mark the rib stock by laying the full-size pattern directly over the wood and scribing a pencil line along the edge of the pattern, Fig. 7. Allow at least 3¼ in. for the width of the rib. After marking the sheer, chine and all water lines on the rib stock, refer to the full-size plan view and measure the angles at the sheer and water lines with a bevel square as indicated at station 4, Fig. 4. Then, mark these angles at their respective water lines as shown in Fig. 6. When making the angle cut on a bandsaw, it is a good idea to have a helper, as in Fig. 5, because he can change the angle of the cut as marked at the various water lines while you guide the board.

Cut two sets of ribs for each frame, but be sure to reverse the angle cut so that the ribs can be assembled as pairs. If a tilting-table bandsaw is not available, you can cut the angle with a wood chisel or block plane after the rib is sawed. However, this method is much slower and not quite as accurate. Mark the line for the

second cut of the rib with a compass or marking gauge set at 3¼ in., as in Fig. 8. Leave the penciled water-line marks on the ribs as they are, but cut a small notch at the load water line so that it can be located after the frame has been painted.

Assemble the frames either on a wooden floor or on two sheets of plywood fastened together. Draw a heavy line on the floor to serve as a centerline and line up the edge of the full-size pattern with it. Then place a bottom and side rib directly over the pattern to assure perfect alignment and temporarily nail a gusset to the ribs to hold them together. Pencil marks made on the floor along the outside edge of the ribs will help locate their position when the paper pattern is slid out and turned over to assemble the ribs for the other side of the frame. When both sides are assembled, carefully check the distances from centerline to sheer on each side and nail the temporary tie bar across at water line 6, as shown in Fig. 10. Then bolt the tie bar across the bottom with its lower edge flush with the notch for the keel apron. The tie bar is 4 in. wide and is made of the same material as the ribs. The gussets are also 1 in. thick and extend about 8 in. each way from the chine corner. Their curves may be drawn freehand.

The gussets are then bolted to the ribs. Before removing the frame from the floor, carefully mark the centerline on the temporary tie bar using a square edge as indicated in Fig. 11.

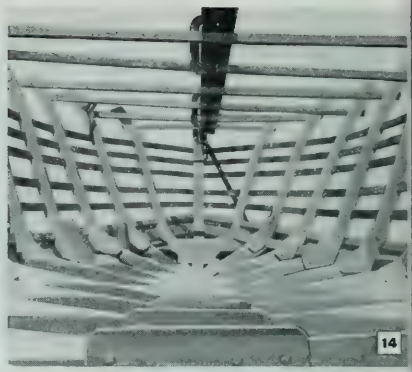


Blocking the Keel

When the keel, apron and bow-stem parts have been bolted together, a suitable erection site must be selected. As a boat of this size, in most cases, requires being built outdoors on uneven ground, blocking is necessary to support the bottom of the keel at the correct angle in relation to the base line. A leveled chalk line stretched between two stakes to correspond to the base line of the profile drawing, will serve as a starting point from which to measure heights of the blocks. The exact heights can be determined by taking measurements from the base line to the bottom of the keel on the full-size profile drawing. Two wedges driven between the keel and a block, Fig. 19, make a close adjustment possible. The bow stem also must be lined up perpendicular athwartships. This can be done with a plumb line fastened to the top of the bow stem, as in Fig. 28.

The transom is made as shown in Figs. 15 and 16. The aft edges of the top and bottom timbers have a convex curve of 12-ft. radius as in the plan view shown previously. The top timber is crowned 2 in. and the bottom timber is notched for the apron, and tapered ⅛ in. from keel to chine on the lower surface. When assembled, the transom is bolted to the keel with a knee block, as indicated in the lower left-hand detail of Fig. 16. It must be perpendicular to the base line and exactly centered on the keel.

Before assembling the rib frames on the keel, refer to the profile view, Fig. 4. Note that the No. 6 frame straddles the station line and that frames 1 to 5 inclusive

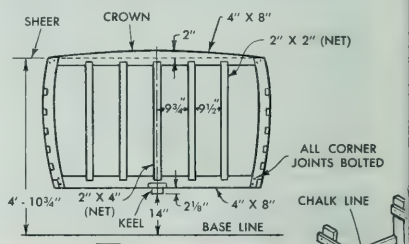


A plank, extending full length of boat and clamped to temporary tie bars, as shown in upper left photo, will help keep frames in proper alignment when installing the battens and planks. Photo above shows interior of the assembled frames looking forward

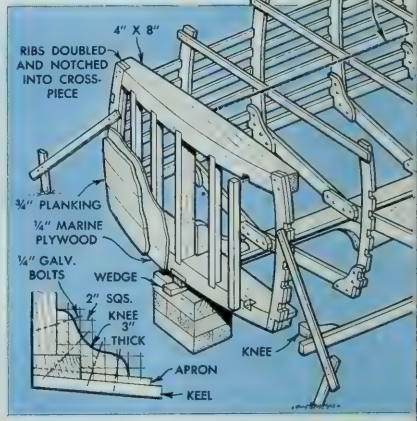
are forward of the station lines, whereas frames 7 to 12 inclusive are aft of the station lines. This refers only to the thickness of the rib and does not apply to the thickness of the tie bar. To start assembling, first mark each station line on the apron. Then draw a second line representing the thickness of the rib and set up the frames between the two lines. Use galvanized lag bolts to fasten the frames to the apron, Fig. 17. A chalk line from the center of the keel to the center of the transom, Fig. 16, is used to line up the frames with the centerlines marked on the temporary tie bars on each frame. The frames also must be at right angles to the keel athwartships and should be well braced.

The chine, which is vertical-grained oak, is fitted to the frames in one piece from bow to stern. To determine the position on the bow stem where the chine notch should be cut, clamp the chine in the rib notches and bend it over to the bow stem. The chine notch on the other side of the bow stem should be exactly opposite this point. Before fastening them permanently, be sure none of the station frames has been sprung out of position. A board clamped across the tie bars as in Figs. 13 and 14 will help keep the frames aligned.

Screw the chines to the bow stem and transom with 1½-in. No. 9 galvanized screws and bolt them to each rib gusset as in Fig. 17. Sea Craft is planked with ¾-in. Philippine mahogany, but other woods such as white cedar or vertical-grained Douglas fir may be used. Be sure that all lumber is boat stock and keep in mind that it must be wider than the final width of the planks. In some cases, a 10-in. piece will make only a 6-in. plank. There is no set width for the finished planking. However, planking of uniform widths will give the

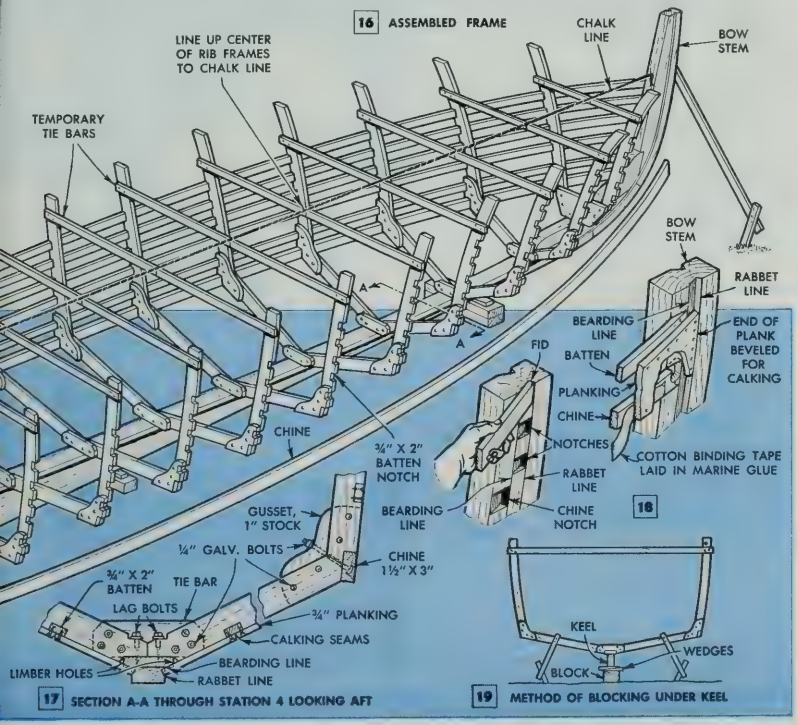


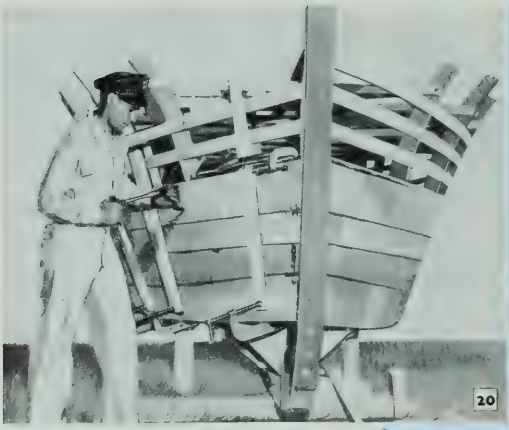
15 TRANSOM

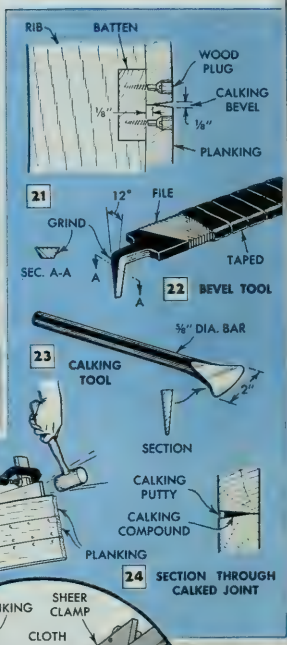


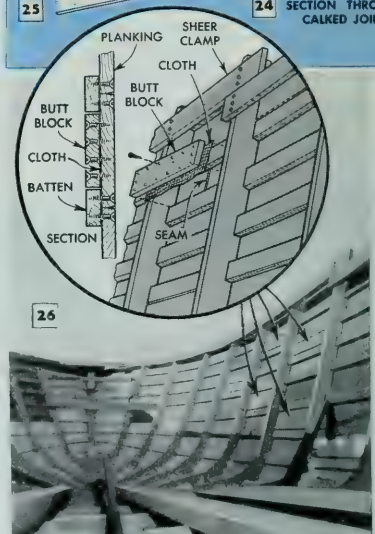
best appearance. The battens are ¾ x 2-in. and of the same material as the planking. They are notched into the ribs and may be spliced over a rib. When laying out the batten notches, measure upward from the bottom of the chine so that the center-to-center distance between the battens will equal the width of the planks. In this way, the seams between the planks will be directly over the centers of the battens as in Fig. 21. The battens are notched into the bow stem the same as the chines so the planking will fit snugly into a rabbet cut in the bow stem, Fig. 18. Notches are cut at intervals between the rabbet and bearding lines and checked for correct depth and angle with a fid, which is a small block the same thickness as the planking, Fig. 18. Then the waste is removed between these notches to form a continuous rabbet. When installing the battens alternate them from port to starboard side to equalize the strain on the frames.

As the side planks lap over the transom planking, the transom must be planked first. Cover the transom frame with ¼-in. marine plywood and fasten with flat-headed screws, countersunk. Then screw ¾-in. mahogany planking over the plywood, counterboring the screw holes to take wooden plugs as in Fig. 21. For a neat appearance, run the grain of the plugs the same way as the grain of the planking. When planking the sides, start at the chine and alternate from side to side, being sure that the plank ends fit correctly into the bow-stem rabbet. Clamp the plank in place at the bow stem and mark for cutting. Then remove, cut and reclamp for further fitting. Repeat until you have a good joint. It will be necessary to steam the forward ends of all planks to prevent breakage. To avoid marring the wood when clamping the planks, use a strip of wood between the clamp and plank as in Figs. 12 and 20. Work from the bow toward the stern, keeping the bottom edge of the plank even with the bottom edge of







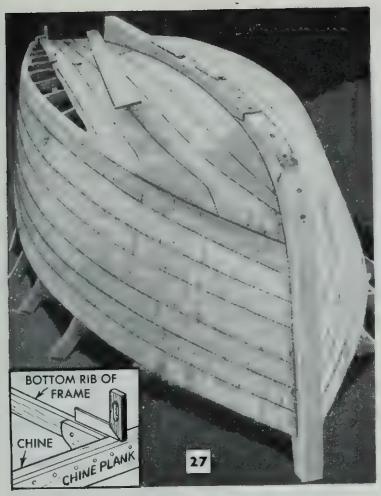


the chine. When in place, mark the inside surface of the plank along the top edge of the first batten. Then remove the plank and draw another line 1 in. in toward the chine edge. This is the cutting line which will bring the edge of the plank over the center of the batten. A slight bevel for calking, as in Fig. 21, should be planed along the edge. Before attaching the plank permanently, coat the chine and lower half of the first batten with marine glue. Apply muslin or cotton binding tape and more glue. Then clamp the plank firmly in place and fasten with 1¼-in. No. 8 flat-headed galvanized screws at the battens and 1½-in. screws at the bow stem. Stagger all screws so they do not run in the same grain and place about 1 in. apart at the bow stem and 3 in. apart along the battens and ribs. Counterbore all screw holes for wooden plugs to be added later.

Planks can be spliced between the ribs amidships where the bend is not severe. A butt block, shown in the inset of Fig. 26, is used to join the ends of the planks. Use muslin and plenty of glue between the block and planks. Splices in adjacent planks should be staggered as in Fig. 26. Binding tape is not needed in seams above the L. W. L. Fig. 25 shows how the edges of the planks are drawn tightly together with wedge blocks.

Turn the boat over after all the side planks, except the sheer plank, are in place. This is left off to prevent it from being damaged. The bow-stem rabbet must be continued along the entire length of the keel, and the apron must be beveled flush with the bottom edge of the ribs. At this time, be sure the notches that serve as

Planks are butted together between ribs and joined with a butt block. Adjacent splices are staggered



limber holes have been cut in the ribs on each side of the apron, Fig. 17. Also be sure the stopwaters are in place. These are ½-in. softwood dowels dipped in paint and driven into holes drilled through the keel athwartships between the rabbet and bearding lines at four places as in Figs. 4 and 9.

The bottom edge of the chine and chine plank must be planed flush with the bottoms of the ribs. Test with a small square as detailed in Fig. 27. The bottom planks, especially forward, require considerable fitting and cutting to bring them to exact shape. A cardboard template for the forward end of each plank will simplify this fitting job. Fig. 27 shows the unusual contours the bottom planks assume at the forward end. It is best to install the bottom battens as the planking proceeds. Binding tape laid in marine glue is used on all bottom planks. Install the planks adjacent to the keel first, and then work toward the chine.

When this much of the planking is completed, wooden plugs dipped in marine glue are driven into the counterbored screw holes and cut off flush with the surface. The plugs can be purchased and should be of the same material as the planking. The bottom of the keel is planed flat to approximately the position of the second station. From this point forward the keel takes a slight bevel, which tapers to a sharp bevel at the bow stem, shown in Fig. 28.

Sand, calk and paint the bottom before turning the hull upright. Although a power belt sander is preferred, a disk sander may be used if care is taken not to gouge the planking. To clean out the plank joints for calking, bend and grind the tang of a file as shown in Fig. 22. Cotton marine calking is driven into the seams with the calking tool shown in Fig. 23. Use plenty of calking along the keel seams. However, one strip between planks is usually enough because room must be left for the calking putty, which is applied with a knife over the calking cotton. The putty is slightly indented below the surface as in Fig. 24. To prevent the bottom from drying out, give it a coat of copper bottom paint. The hull is quite heavy now so probably you will need more help to turn it over. As the boat will remain in this position until it is finished, level the L.W.L. and securely block the hull in position.

Next, install the top or sheer planks. Carefully fit the bottom edge of the planks and clamp in position on the hull. Transfer the sheer-line marks on the ribs to the sheer planks and cut them slightly oversize at the sheer lines to allow for planing later. When the sheer planking is in place, plug the screw holes and calk the seams. Then sand the transom smooth, fill with a mahogany-colored wood filler and follow with two coats of marine varnish. The inside of the hull is painted with a mixture of white lead and linseed oil.

The best way to bevel the edge of the bow stem is with a wide wood chisel as shown in Fig. 28. Although there is enough

stock to bring the stem to a sharp edge, most boatbuilders prefer a flat edge about ¾ in. wide which is faced with a half-round metal strip.

Mounting the Engine

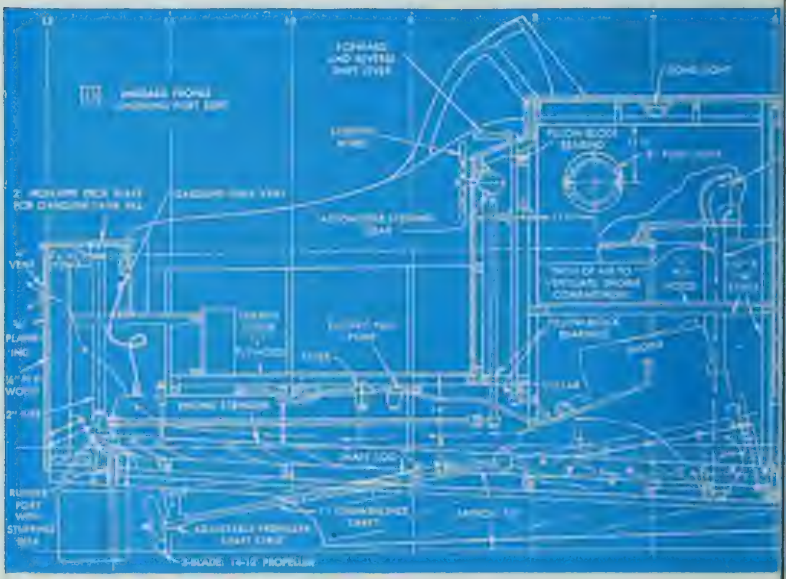
When the planking is completed and the seams below the L.W.L. have been calked, sand and give the planking a coat of flat white paint. The seams above the L.W.L. are filled later with a plastic seam sealer. When sanding, keep the machine constantly in motion to avoid sanding one area more than another, thus causing low spots.

The 1 x 3½-in. oak sheer clamps, shown in Figs. 31 and 38, extend from the transom to station 2. Note in Fig. 30 that one clamp is placed above the other at station 7 where the sheer line drops. When screwing the clamps to each rib, allow the top edges of the clamps to project above the hull sheer line slightly. These are later planed down to come flush with a 2-in. crown in the decks. The sheer clamps from station 1 to the bow stem are lapped and bolted to the long sheer clamps at station 1 and are fastened to the bow stem with a block.

At this time, decide what kind of an engine will be used in the boat. A marine engine is best. However, many automobile engines work well when converted to marine use. Kits are available for converting the engine yourself, or a marine machinist can convert your engine by removing all gears except the reverse and high gears and installing a thrust bearing. A water pump to circulate cooling water also is necessary. Sea Craft's Chrysler engine, Fig. 29, was converted in this way. Note the extra oil sump welded to the bottom of the oil pan to permit the engine to operate on an angle.

The engine-bed pieces, Fig. 33, are made of 2-in. oak and bolted to the engine stringers, Fig. 38, which extend from the transom to a 2 x 4-in. tie bar, which replaces the original tie bar on the frame of station 6. The engine stringers are placed approximately parallel with the keel apron, and are notched out and screwed to the lower transom beam and ribs. If placed 19 in. apart they will accommodate most engines. However, this dimension should be checked with the engine before installing them. The floor stringers, Figs. 33 and 38, are bolted to the outside of the engine stringers and are notched for the ribs to which they are screwed. The port stringer extends from station 3 to ⅝ in. forward of station 8; starboard stringer from station 3 to 11⅝ in. aft of station 8.

Before determining the shape of engine-bed pieces and the location of the propeller-shaft hole, the exact position of the engine in the hull must be determined. This can be done best by making a full-size, cutout pattern of the engine profile on heavy pa-

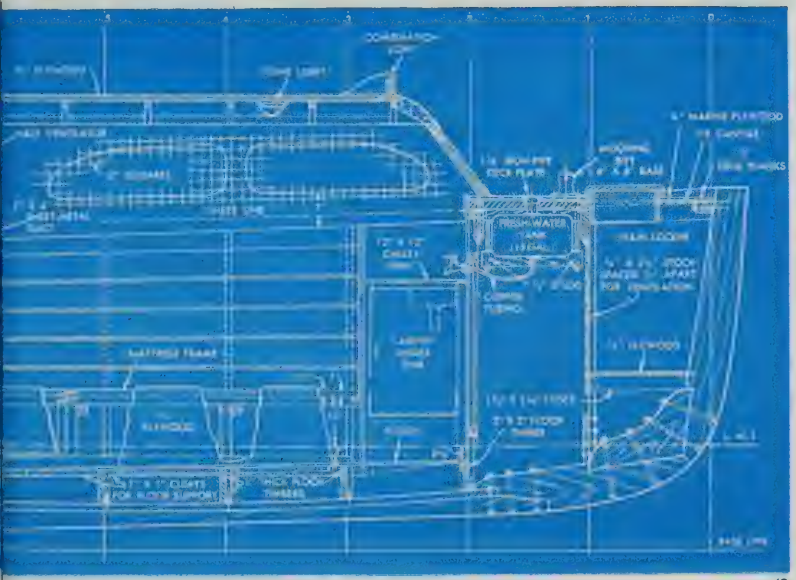


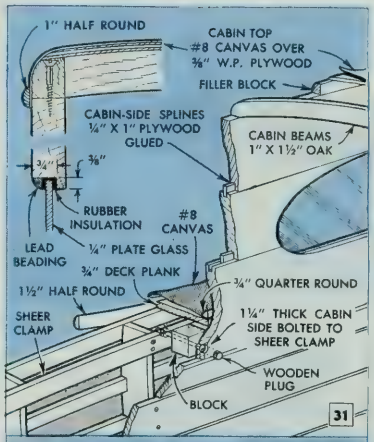
per. Carefully mark the location of the mounting brackets and center line of the crankshaft on the paper. Place the pattern on the full-size profile drawing between stations 6 and 8 and shift it around until the crankshaft center line is at an angle of 10 deg. or less with the L.W.L. Check the oil pan, flywheel and the transmission housing for clearance with the apron and ribs. When the engine pattern is in position, Fig. 30, fasten it down with tape and draw an extension of the crankshaft line across the keel and apron. Other parts, such as the rudder, propeller, shaft log, rudder post and propeller-shaft strut, shown in Figs. 30 and 33, should be on hand so they may be sketched in on the profile drawing to check for clearance.

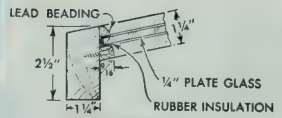
A method of holding the bit at the correct angle when drilling the propeller-shaft hole is shown in Fig. 32. The braces and starting block should be sketched on the profile drawing and their exact location transferred to the hull. Since the propeller shaft is 1-in.-dia. Tobin bronze, the hole must be 1¼ in. It is started with a regular wood bit because a "barefoot"

29

Auto engine converted to marine use gives dependable, low-cost power. Only high and reverse gears are used

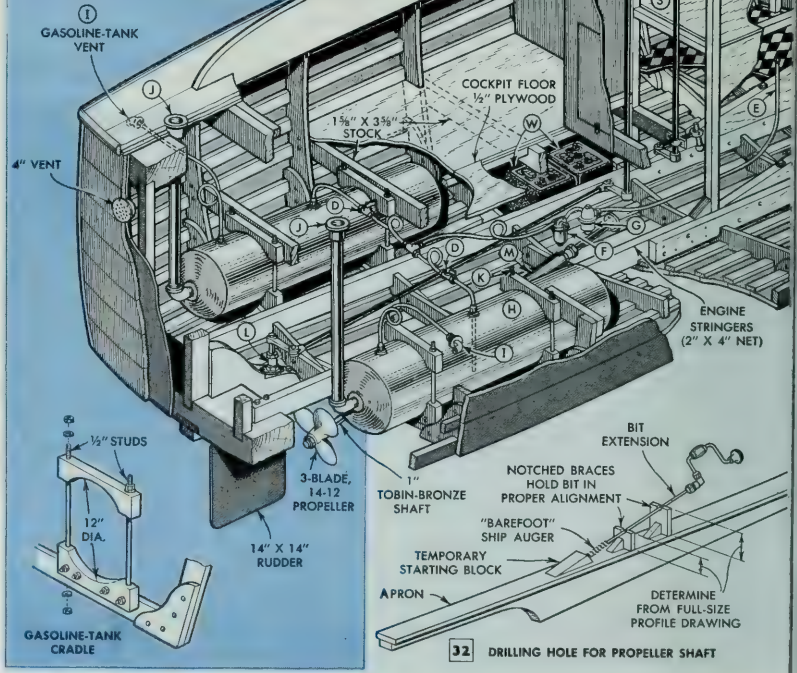




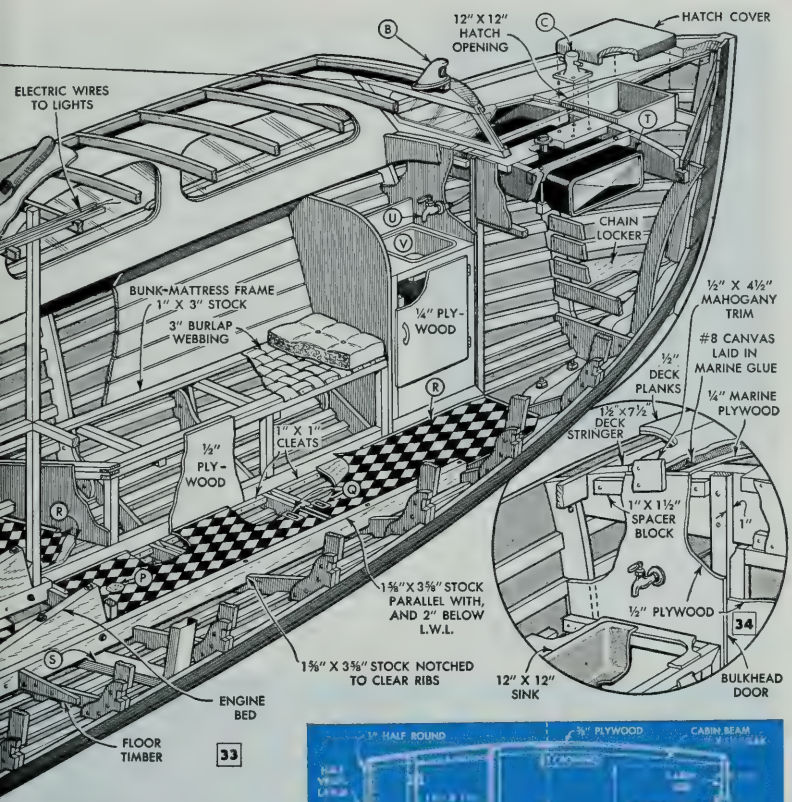


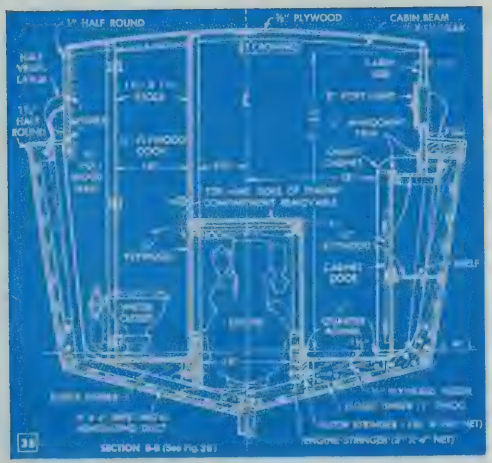
SECTION THROUGH WINDSHIELD

Drawings by Eldon Schiel



32 DRILLING HOLE FOR PROPELLER SHAFT





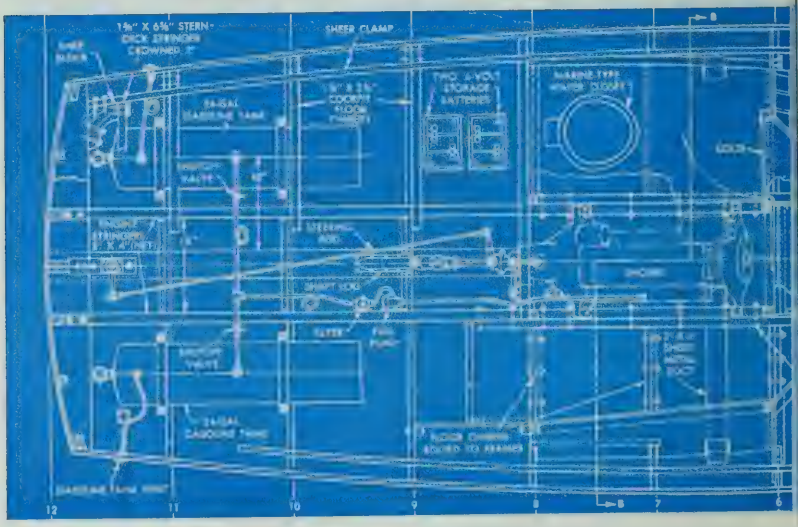
A—MAST LIGHT
B—COMBINATION LIGHT
C—MOORING BITT (6" X 6" BASE)
D—GASOLINE-LINE SHUTOFF VALVE
E—COPPER TUBING (GASOLINE LINE)
F—GASOLINE-LINE FILTER
G—ELECTRIC FUEL PUMP
H—24-GAL. GASOLINE TANK
I—THROUGH-HULL, GASOLINE-TANK VENT
J—PIPE DECK PLATE (For Filling Gasoline Tank)
K—½" STUDS
L-RUDDER PORT WITH STUFFING BOX
M—PROPELLER-SHAFT LOG
N—MARINE COMPASS
O—FORWARD AND REVERSE SHIFT LEVER
P—DRAIN PLATE
Q—FLUSH-TYPE LIFTING HANDLE
R—FLOOR (½" PLYWOOD COVERED WITH LINOLEUM)
S—2" X 4" SHEET-METAL VENTILATING DUCT
T—15-GAL. FRESH-WATER TANK
U—FRESH-WATER FAUCET
V—12" X 12" GALLEY SINK
W—TWO 6-VOLT STORAGE BATTERIES

ship auger has no lead screw. In the event the hole runs out slightly, a bar of iron heated red-hot can be used to burn the hole in the proper direction.

Next, bolt the propeller-shaft strut to the keel, and drill a hole through the transom knee, apron and keel to take the rudder port. Locate the positions of the strut and port from the sketches made on the profile drawing. Assemble the shaft log to the apron temporarily with two wood screws and insert the propeller shaft. A flanged coupling is used to connect the shaft to the engine. The engine stub shaft and the propeller shaft will require some machining to take the flanged coupling. After setting the engine on its bed, it can be lined up with the shaft by bringing the faces of the coupling flanges together and gauging the distance between them at four places 90 deg. apart around their periphery with a mechanic's feeler gauge. The shaft log may have to be shifted somewhat and the engine raised or lowered to get them in proper alignment. If the installation makes it impossible to line up the engine and shaft, a universal joint and thrust bearing can be installed between the coupling and shaft log. After the boat has been in the water a while, the propeller shaft may start to "pound" due to dampness from the bilge swelling the engine bed and throwing the motor out of alignment. However, once the motor has been realigned it rarely requires further adjustment.

Although many boats do not have a clutch-control pedal, it will be found useful. If an automobile engine is used, it is a simple task to saw off the clutch pedal, install the necessary linkage and connect to a foot pedal extending out of the control box, Fig. 37. The gearshift lever also is sawed off and connected to the forward and reverse lever as in Figs. 30 and 38.

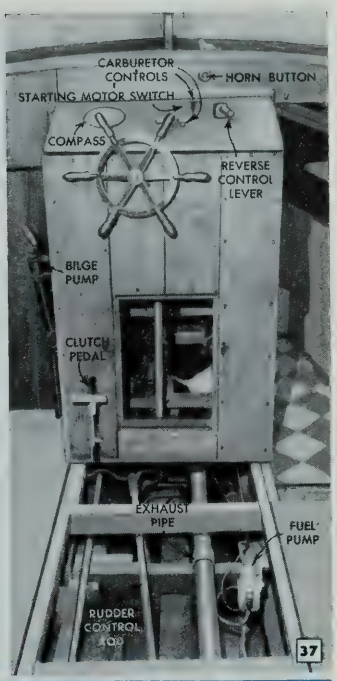
Water to cool the engine is piped from an



intake scoop to the pump. The scoop is fitted in a hole drilled in the bottom of the hull. Engine exhaust gases are carried through a 2½-in. galvanized pipe from the engine manifold to a hole in the transom 2 in. above the L.W.L. Cooling water from the engine also runs out the exhaust pipe. Asbestos must be wrapped around the exhaust pipe between the manifold and the cooling-water-pipe connection. The water keeps the rest of the exhaust pipe cool.

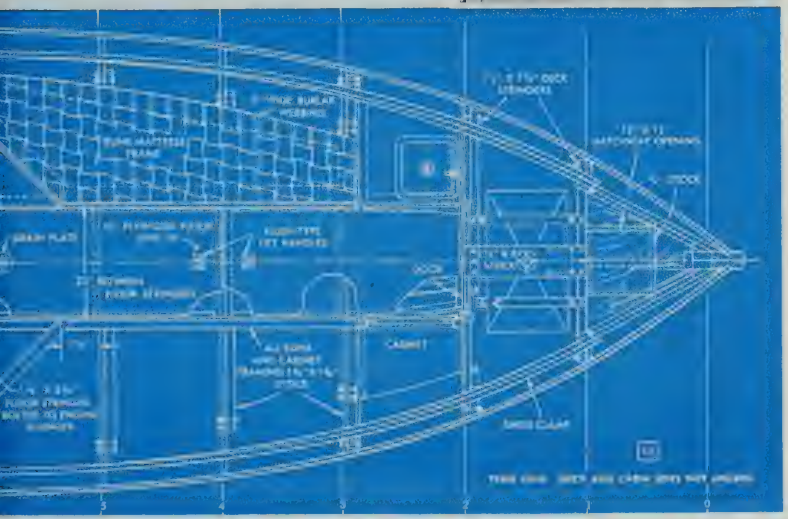
Sea Craft has two 24-gal. round tanks supported by cradles. However, any type of marine gasoline tanks can be used provided they have the fill pipe connected to deck plates located on an open deck so there is no danger of gasoline being spilled into the bilge. The tanks also must be vented through the hull as indicated. Copper tubing, coiled to absorb vibration, carries the gasoline to the engine by means of an electric pump. The tank outlet is the type fitted to the top of the tank to minimize the possibility of leakage.

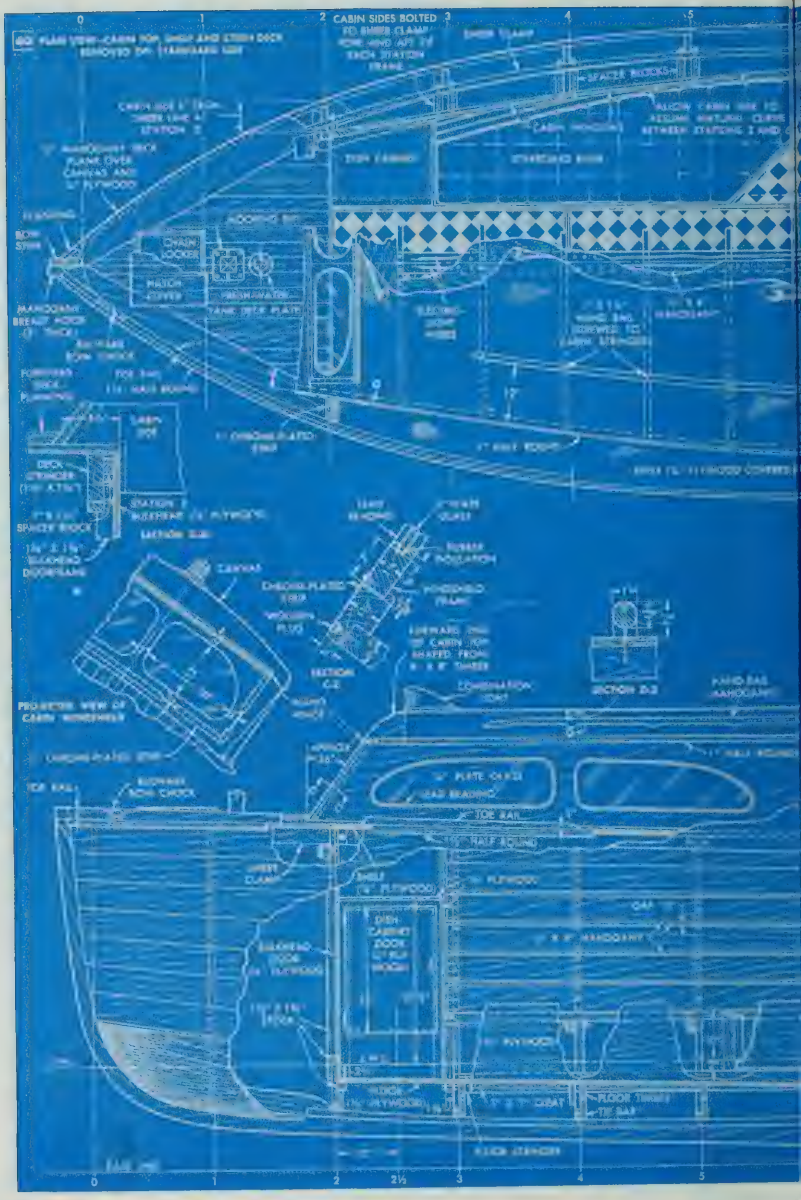
Air for engine and bilge ventilation is supplied by sheet-metal ducts between stations 6 and 7, Figs. 30 and 35. Circulation is maintained by two plate vents in the transom.

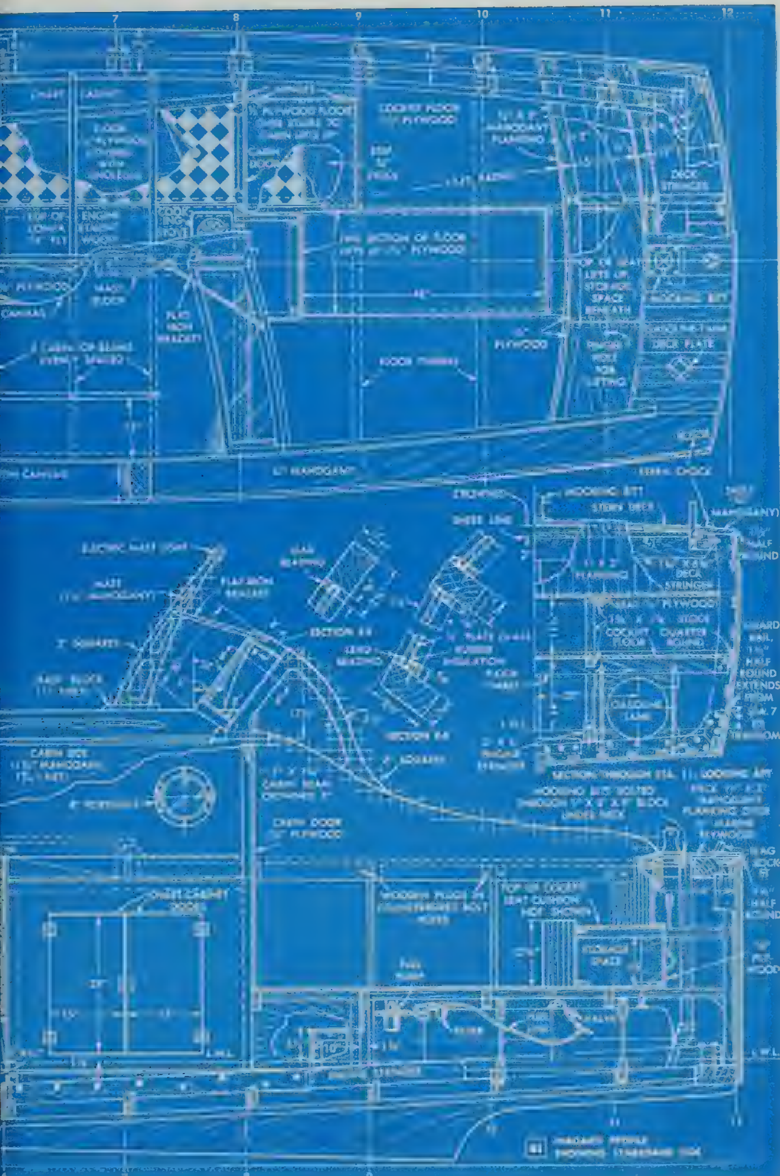


Cabin Construction

The size of the cabin and the arrangement of the bunks, cabinets and bulkheads is a matter of personal choice and may be changed without affecting the performance of the boat. If more headroom is required, the cabin sides can be made higher or, if less headroom is desired, the cabin floor may be raised slightly.




CABIN SIDES BOLTED TO SHEER CLAMP
SHEER CLAMP
SPACER BLOCKS
CABIN SIDE
STATION 1
STATION 2
STATION 3
STATION 4
STATION 5
CABIN TOP
MAHOGANY DECK PLANK OVER CANVAS AND ½" PLYWOOD
BOW STEM
CABIN DOOR
MOTOR COVER
NAVIGATION LIGHT
FORE DECK PLANKING
MAHOGANY BREAST HOOK
KEEL
FORE DECK BEAM
DECK STRINGER
SPACER BLOCK
STATION 1 BULKHEAD
SECTION A-A
SECTION C-C
SECTION D-D
CANVAS
CHECK PLATED STRIP
WINDSHIELD FRAME
RUBBER INSULATION
COMBINATION LIGHT
PROJECTION VIEW OF CABIN WINDSHIELD
ANCHOR
ANCHOR LINE
BOW CHOCK
SHEER CLAMP
SHELF
DISH CABINET DOOR
DOOR
FLOOR TIMBER
FLOOR STRINGER
KEEL



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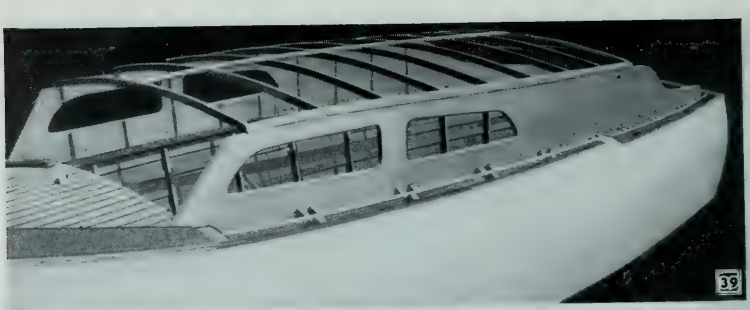
8
9
10
11
12
CHART CABINET
COCKPIT FLOOR
DECK STRINGER
TOP OF SEAT LIFTS UP STORAGE SPACE BENEATH
MOORING BITT
DECK PLATE
FINGER HOLE FOR LIFTING
FLOOR TIMBERS
STERN CHOCK
MOORING BITT
STERN DECK
SHEER LINE
ELECTRIC MAST LIGHT
SECTION B-B
SECTION A-A
CABIN DOOR 1/2" PLYWOOD
SECTION THROUGH STA. 11, LOOKING AFT
STORAGE SPACE
L.W.L.



Also, the length of the cabin can be shortened to provide a larger open cockpit. However, regardless of the changes made, the methods of construction shown in the drawings should be followed. All structural members must be fastened to the frames, never directly to the hull planking. Stock-size fir or spruce can be used for most of the framing and the plywood must be of the type made especially for marine use.

Sea Craft's forward deck extends from the bow to station 2. Two deck stringers, shown in the upper drawing of Fig. 42, are bolted to the aft and forward sides of the frames at stations 1 and 2 as shown in Fig. 38. The top edges of the stringers are notched for the cradle of the fresh-water tank and a 1½ x 6-in. center beam, which is bolted to the stringers as shown in Figs. 30 and 38. The shape of the cradle, which is made of 1½ x 3-in. oak, must be determined by the tank dimensions. Refer to the perspective drawing, Fig. 33, for clarification. The frame for the hatchway opening, indicated in Fig. 38, projects 2 in. above the stringer. This opening gives access to the chain locker, which is floored and partitioned as shown in Figs. 30 and 42. Cleats of 1 x 1-in. stock, screwed to the sides of the hatchway frame flush with the top edge of the stringer, support the ¼-in. plywood, which is screwed down to cover the entire deck area. After the plywood has been covered with marine glue and canvas, it is planked with ½ x 3-in. mahogany. The white lines between the planks are made by beveling the planks slightly, as for calking, and then filling the resulting grooves with sealing compound. Although the 3-in. planking can be laid to the sheer line, a margin plank on each side, as in Fig. 40, will improve the appearance. Details of the bulkhead at station 2 are given in Figs. 41, 42 and 43.

The cockpit floor is supported by timbers which extend athwartships and bolt to the forward sides of frames 9, 10 and 11 and the aft side of frame 8. A portion of the cockpit floor timber at station 8 is sawed out later for the stair well to the cabin. Note in Fig. 40 that the center section of the floor is removable and that it rests on two strips of 1⅝ x 1⅝-in. stock which are notched into the athwartship floor timbers. The outboard edges of the strips are located directly above the engine stringers. These pieces extend from station 8 to the vertical transom braces. Fig. 37 shows this section of floor removed.

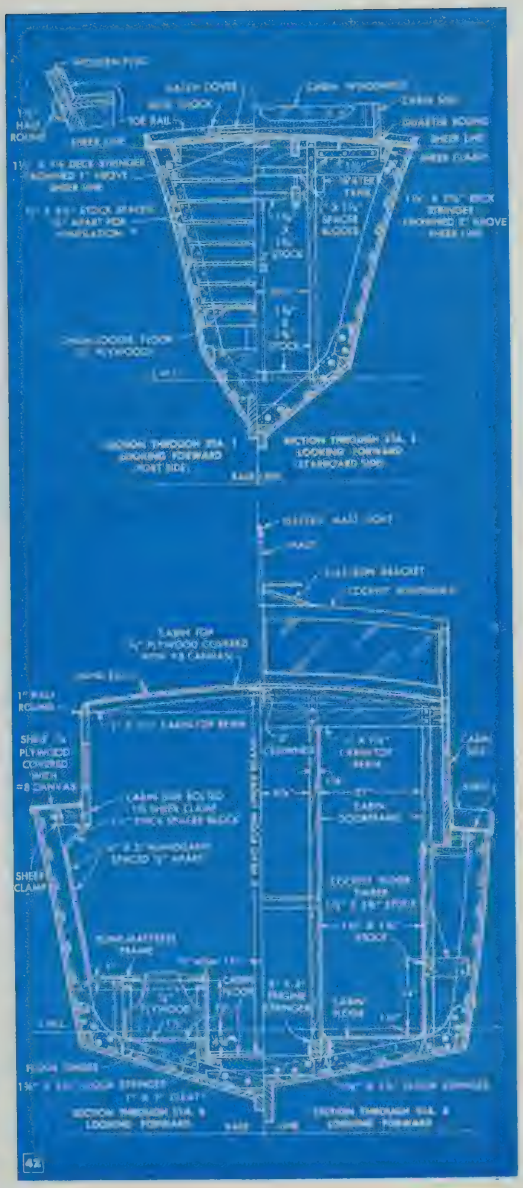
The stern-deck stringer, which is crowned 2 in., the same as the top transom timber, is placed 16 in. forward of the transom and lag-bolted to a 3-in. knee block fastened to the sheer clamp and transom timber as indicated in Figs. 40 and 41.

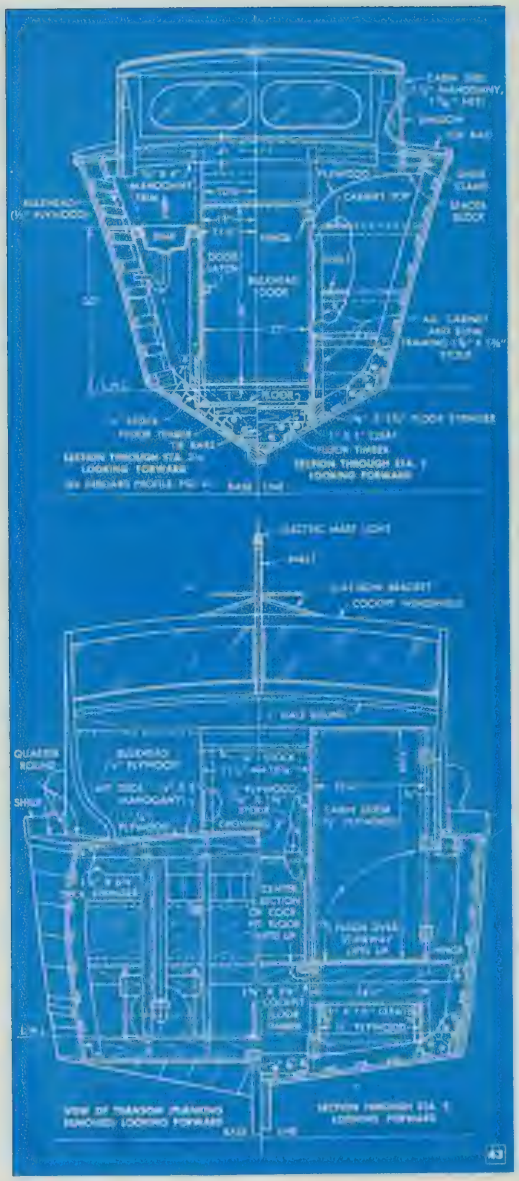
The cabin sides are installed next. First make the 1½-in.-thick spacer blocks shown in Fig. 40. Considerable fitting will be required when installing the blocks. The inboard edges of the blocks must be perpendicular to the base line and their top edges must be on a slight downward angle to the sheer line to coincide with the 2-in. crown of the decks. When fitted, toenail them to the sheer clamp. Note that the dimensions for the blocks at stations 3, 4 and 5 have been omitted. These are installed after the cabin sides are clamped in position.

Each cabin side is made up of three pieces of 1¼-in. (1$^{3}/_{16}$ in. net) mahogany, splined and glued as indicated in Fig. 31. The total width of the glued-up boards should be not less than 28 in. If three 9½-in. boards are used, each side will require two pieces 20 ft. long and one piece 16 ft. long. However, if the headroom is to be increased, the width of the cabin sideboards must also be increased. To lay out the shape of the sides, joint the seam edges of the boards and lay them together on a flat surface. As the lower corners of the cabin sides are notched to fit 3½ in. below the sheer line between the bulkhead at station 2 and the stern-deck stringer, the developed length must be obtained. This can be done best by fairing a batten against the

blocks and cutting it off to fit between the bulkhead and the stringer.

With the batten in place, mark the position of each station on it, then remove, place on the cabin sideboards and transfer the station locations to the sideboards. Draw lines across the boards perpendicular to the seams at the station marks and ends of the batten. Note in Fig. 40, section G-G, that the cabin side projects over the forward deck 5½ in. A chalk line parallel with and 64¼ in. above the L.W.L. is stretched between two temporary upright braces at station 2 and the transom to represent the top of the cabin sides. The distance between the chalk line and the bottom of the sheer clamp or blocks at each station is measured and transferred to the cabin sideboards. A line connecting these points gives the bottom cutting line of the cabin side. The line between stations 6 and 7 drops abruptly because of the sheer drop. The curved lines of the cockpit sides and cutouts for the windows are drawn freehand with the aid of a pattern of squared lines drawn lightly on the boards as in Figs. 30 and 41. The aft ends of the cabin sides project about 1⅝ in. over the stern deck. When cutting the spline grooves, stop them so they will not run out in the end grain of the windows and the curve of the cockpit sides. The forward edge can run out as it is covered by the windshield frame. When assembling the boards, use marine glue and clamp securely until dry. Then lay out the port-light hole and the forward end which slopes about 36 deg. off the vertical. After sawing, rabbet the edges of the window openings, as

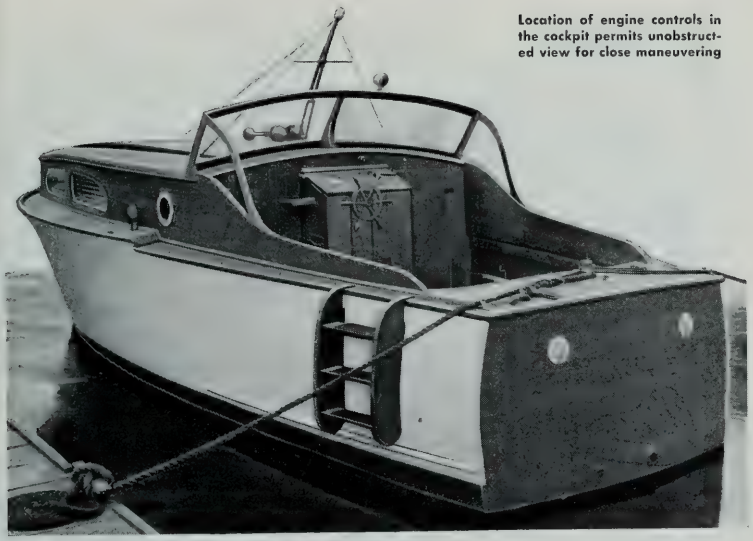




shown in Fig. 31, to take the plate-glass windows, which are installed later. As both cabin sides are the same, the completed one can be used as a pattern to lay out the second side. Care should be taken to make the rabbeted edge around the window openings on the outside of each piece.

When installing the cabin sides, nail temporary tie bars across frames 5, 6 and 7 just below the sheer clamps, and use timbers and wedges or automobile jacks at stations 6 and 7 to force the cabin sides against the spacer blocks. Before making the spacer blocks for stations 3, 4 and 5, wedge and clamp the cabin sides until they are fairly straight between stations 2 and 5 so the window glass will seat tight against the rabbeted edges. When the sides are clamped firmly in position, bolt them to the sheer clamps at each spacer block with large-headed, ⅜-in. galvanized carriage bolts. Countersink all bolts and plug the holes for neat appearance.

Before removing the clamps, install the cabin-top beams shown in Figs. 35 and 40. The forward beam is placed 7¼ in. aft of the forward top corners of the cabin sides. The other frames are spaced uniformly with one directly above the frame at station 6. They are screwed to the top edge of the cabin sides and have filler blocks between them as in Figs. 31 and 39. The aft beam is cut off flush with the inboard sides of the cabin sides and screwed to the 1 x 7¾-in. beam shown in Figs. 41 and 42. The top sides of the beams are notched in the center to take a ½ x 4-in. piece of mahogany as shown in Fig. 40.



Location of engine controls in the cockpit permits unobstructed view for close maneuvering

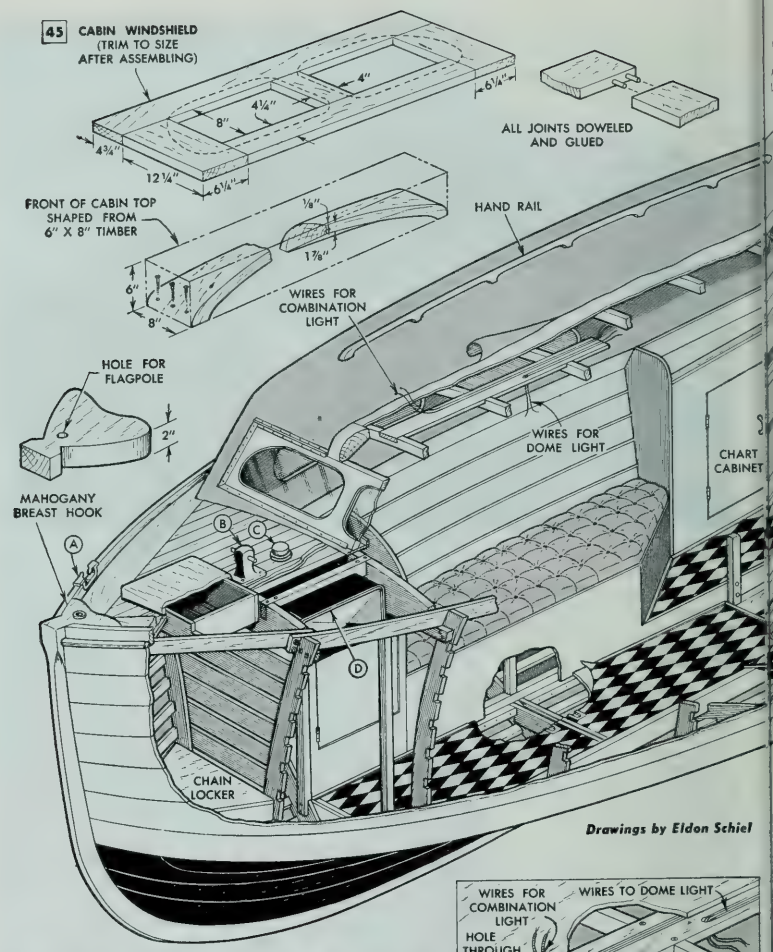
Stock-size lumber is used for the cockpit-bulkhead framing dimensioned in section 8 of Fig. 42. The framing for the engine compartment, toilet room and chart cabinet, shown in Figs. 30 and 35, is an integral part of the bulkhead framing and should be installed at this time.

Finishing the Cabin

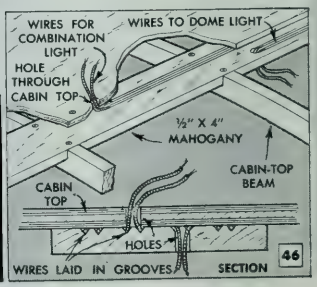
Continuing with the cabin interior, install the framing and plywood covering of the port and starboard bunks and forward cabinets. The top of the port-side cabinet is cut out to take a 12 x 12-in. galley sink, which drains through the hull, as in Fig. 43. Fresh water is piped to a faucet fitted through the bulkhead, Fig. 30. The bunk mattresses are supported on a removable frame woven of burlap webbing, as in Fig. 33. They are kept in place by a 1½-in. projection of the plywood bunk sides, which extend down over the inboard sides of the floor stringers. The hull ribs above the bunk frames are covered with ½-in. mahogany, Figs. 41 and 42. The center of the cabin floor is made in two removable sections, each supported by cleats fastened to the plywood bunk sides and floor timbers which are bolted to the frames on top of the tie bars (see station 3, Fig. 43). Note that the floor slopes to obtain maximum headroom at station 6. The cabin floor on both sides of the engine compartment is fastened permanently to the top edges of the floor stringers and floor timbers, Figs. 35 and 38.

Before covering the cockpit-bulkhead framing, install the water closet, which must be purchased from a marine supply house. Plywood is used for the walls and doors of the toilet room, engine compartment and chart cabinet. Note in Fig. 35 that the sides and top of the engine compartment are removable. They also must be lined with asbestos. The sides are held in place at the top by hooks and at the bottom with quarter round nailed to the floor. One side and the top are shown removed in Fig. 36. An alcohol cooking stove is bolted in a sheet-metal cabinet mounted on the bulkhead frame. The cabinet must be removable for access to the rear of the control box as detailed in Figs. 43 and 49. This box houses the compass, electrical switches, engine controls and steering gear. An inspection door in the front of the box, Fig. 37, is held in place with brass door buttons and plates.

The steering system, Figs. 30 and 38, consists of an automobile steering knuckle of the worm-gear type bolted in the control box so that a steering wheel can be fastened to the worm shaft. The stub shaft of the worm gear is welded to a vertical shaft extending below the cockpit floor. Lever arms attached to the lower end of the shaft and rudder post are connected with a steering rod of ½-in. pipe, which has a clevis welded to each end. A hand-operated bilge pump is fastened to the port side of the control box with the outlet joined to a ½-in.

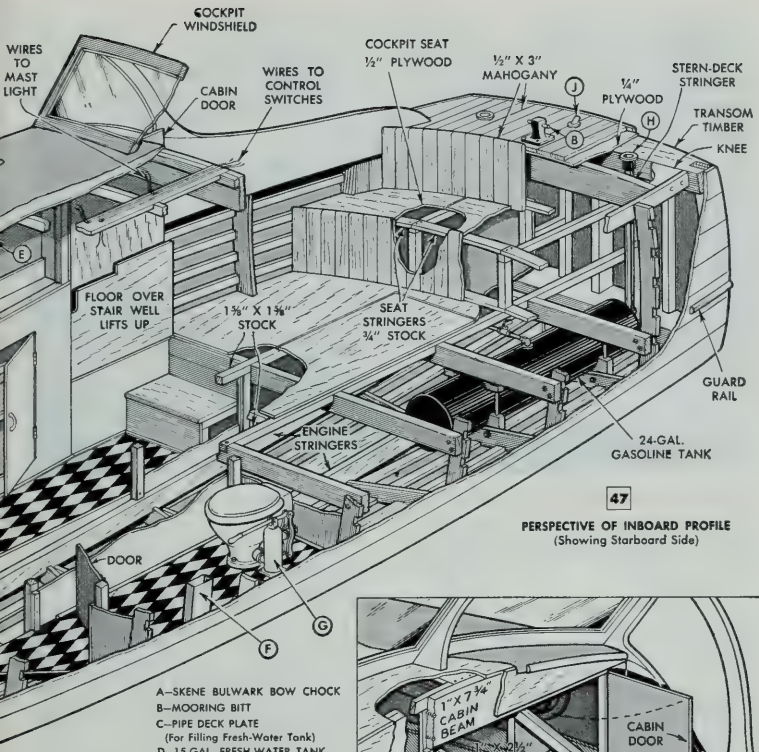


Drawings by Eldon Schiel



"SEA CRAFT" BLUEPRINTS AVAILABLE

SINCE IT IS DIFFICULT TO REPRODUCE BLUEPRINTS TO A WORKING SCALE WITHIN THE LIMITS OF A PRINTED PAGE, A COMPLETE SET OF SEVEN LARGE-SIZE BLUEPRINTS SCALED 1 IN. TO THE FT. MAY BE PURCHASED FROM POPULAR MECHANICS BOOK DEPARTMENT, 200 E. ONTARIO ST., CHICAGO 11



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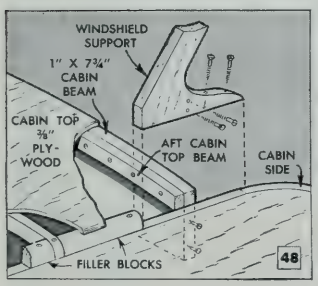
PERSPECTIVE OF INBOARD PROFILE
(Showing Starboard Side)



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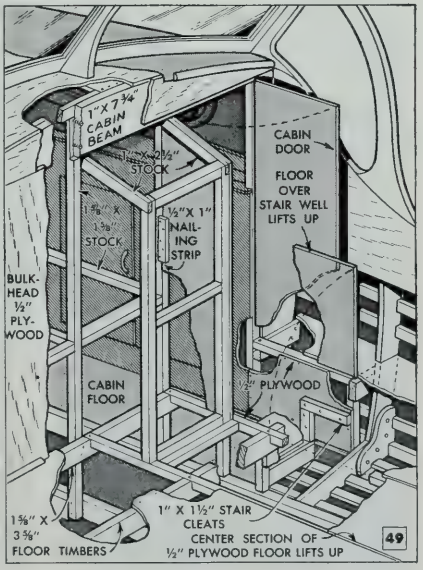

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"Sea Craft's" lines show to best advantage when viewed off the bow. Cabin roof can be used for sun bathing

galvanized pipe running under the cockpit floor to a hole in the transom. The pump intake is connected to a hose extending down to the bilge.

The cabin stairway, Figs. 41 and 43, is covered with a trap door which projects under the cabin door when closed, preventing entrance to the cabin when the cabin door is locked.

Two 6-volt storage batteries, placed in a box under the cockpit floor are connected to a S.P.D.T. switch located in the control box. The wiring hookup should be arranged so the batteries may be used individually.

The stern deck is made of the same material as the forward deck. It is crowned 2 in. and the forward edge curved to conform with the radius of the cockpit seat, as in Fig. 47 and also Figs. 40 and 41. The seat top is made from three pieces of plywood and is removable for access to storage space beneath. This provides an ideal place to store life preservers. The side decks or shelves, extending from the sheer drop to the transom, should be installed at the same time as the stern deck. They are of ¾-in. mahogany cut to fit snugly against the cabin sides and trimmed flush with the hull planking. The shelves, forward of the sheer drop, are of ¾-in. plywood covered with canvas to provide a nonslip surface. They must be notched to clear the ventilating ducts. A block of wood is inserted between the fore and aft shelves where the sheer line drops, and ¾-in. quarter round is used along the joint of the shelf and cabin side.

Before the cabin top is put on, cut grooves in the center strip for the insulated electrical wires, as in Figs. 46 and 47. These wires, which are connected to switches on the control-box panel, are brought through holes in the cabin top to the combination light, mast light and a horn which is required for a boat of this size. The wires leading to the cabin dome lights and toilet-room wall light, which have individual switches, are connected directly to an ammeter on the panel.

The two outer supports for the cockpit windshield are shown in pattern squares in Fig. 41. Each side is made from two pieces doweled and glued together at the top and screwed to the top edge of the cabin sides, Fig. 48. For the cabin roof, two pieces of ⅜-in. plywood 4 x 12 ft. are needed. These are joined at the center, notched to clear the windshield supports and come flush with the bulkhead covering, and are trimmed slightly oversize along the cabin sides. When screwing the roof to the center strip and cabin-top beams, start at the center and work outward. Saw off the forward end of the plywood flush with the front edge of the first cabin-top beam and plane the sides to a well-rounded corner to blend into the filler blocks. The front of the cabin top is shaped from a timber, as in Fig. 45. The entire top is coated with canvas cement and one piece of canvas stretched tightly and tacked along the sides just below the seam between the filler blocks and cabin sides. The forward edge of the canvas is

Top of the engine compartment serves as a table when preparing food in the cruiser's cabin

tacked under the front edge of the shaped timber and the aft edge is tacked to the bulkhead. The canvas then is given several coats of thinned paint. Half-round mahogany molding covers the tacked edges of the canvas along the cabin sides and bulkhead. The cockpit windshield is completed, as in sections F-F and E-E of Fig. 41. The mast, also detailed in Fig. 41, supports a white light. Section D-D of Fig. 41 gives the dimensions of handrails fitted to the cabin top.

The cabin windshield, Fig. 45, fits into a rabbet cut in three pieces of 1½-in. stock, two of which are screwed to the forward edges of the cabin sides, section C-C of Fig. 41, and one placed horizontally across the forward deck. Widths will vary somewhat with each boat. Note in Fig. 47 that the rabbet on the athwartship piece is cut at an angle to fit a 36-deg. bevel on the lower edge of the windshield. Toe rails extending from the breast hook at the bow to station 4 on both sides along the sheer, Figs. 40 and 41, are screwed to the deck planking as in the upper detail of Fig. 42. The seam between the hull and deck planking at the sheer is covered with 1½-in. half-round molding. This also is used for the guard rail at the aft end of the hull, Fig. 41. The hatch cover for the chain locker should be a snug fit. It is planked with ½ x 3-in. mahogany over ¼-in. plywood, which is rabbeted into the top edges of the cover frame.

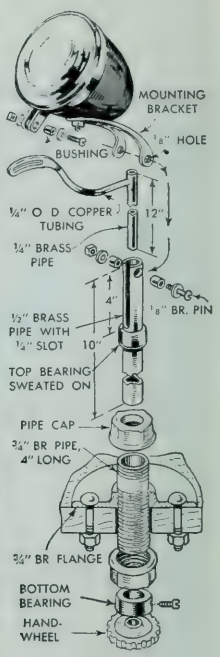
Before painting the exterior, mark the L.W.L. on the hull and fill the planking seams above this line with a fresh or salt-water seam sealer. Give the hull three or four coats of flat-white marine paint above the L.W.L., sanding the hull by hand after each coat. Then apply a mixture of flat and glossy white paint and follow with a coat of glossy white. The decks, cabin sides and windshield frames are sanded, and a mahogany-colored wood filler or a stain is applied, after which three coats of marine varnish are applied, sanding the first two coats. Deck-plank seams are filled with a white seam sealer before varnishing.

All exterior hardware is installed next. The fore and aft mooring bitts must be bolted securely in position to withstand considerable strain. Plate glass for the windshields and cabin windows is held in place with lead beading, as in Figs. 31 and 41. Mahogany on the interior of Sea Craft's cabin was stained and varnished and the plywood painted white, as in Fig. 44. The boat must be provided with a fire extinguisher which should be mounted on the cabin side wall above the chart cabinet. Give the bottom of the hull another coat of copper bottom paint and launch while the paint is wet.

A boat of this size must carry registration numbers. Application for a certificate of award of number can be made by the boat owner to the District Coast Guard Officer having jurisdiction over the area in which the owner resides. See page 175.

In addition to a set of seven working-size blueprints, full-size paper patterns for the hull frames and keel are also available from the Blueprint Department of Popular Mechanics Press.

Sealed-Beam Auto Headlight Makes Spotlight for Cabin Cruiser



AN EFFICIENT, low-cost spotlight for a cabin cruiser can be made from a sealed-beam car headlight of the bumper-mounted type. The unit is controlled remotely from inside the cabin and throws an elliptical spot a quarter of a mile or more, making it ideal for sighting buoys. The headlight is pivoted on its original mounting bracket which is cut and drilled to suit. The rest of the unit is made from brass pipe fittings, with the exception of a piece of ¼-in. copper tubing used as an arm for controlling the light vertically. However, galvanized fittings will do if desired. The unit is attached to the cabin roof by means of a pipe flange through which a 4-in. length of pipe is turned. Note that the threads of the pipe are extended so it can be screwed into the flange to project below the cabin ceiling. Seam compound is applied liberally around the hole in the roof before the flange is screwed or bolted in place. The pipe caps attached to each end of this length of pipe are faced or filed flat and center-drilled to take a ½-in. pipe. The slotted ½-in. pipe for lateral control is polished smooth. The slot also is polished to allow the control arm to slide freely. A top bearing is provided by sweat-soldering a collar to the pipe just below the slot. Another collar, which is a slide fit on the pipe, is attached to its lower end with a setscrew and serves as a bottom bearing. The 12-in. length of ¼-in. pipe which raises and lowers the control arm should be a sliding fit inside the ½-in. pipe and will require bushing. This can be done by spot-soldering shim stock to the inside of the ½-in. pipe at the bottom of the slot and at the lower end of the pipe. One end of the control arm is flattened and slotted and the other end is threaded to screw into a hole tapped in the ¼-in. pipe. If equipment is available, these parts should be brazed together. Note how this arm is bent to permit raising the light. The mounting bracket of the lamp is attached to the ½-in. pipe with a brass pin and set of spacers, the latter taking up the difference between the spread of the bracket arms and the outside diameter of the pipe. The lens clamp of the headlight is attached to the control arm with a bolt having a bushing which rides in the slot. After the unit is assembled, the bottom bearing is tightened so there is a slight drag when the spotlight is turned. Finally, a small handwheel is added to the lower end of the ¼-in. pipe to manipulate the light. Wiring is done by bringing the wire down through the ¼-in. pipe and connecting it through a switch on the light itself or on the light panel of the boat. The light is grounded in order to complete the electrical circuit.

Keep Your Tobacco Dry

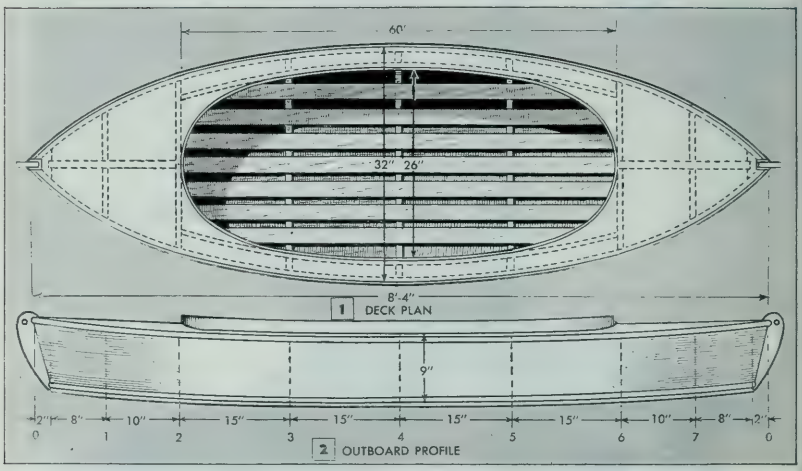
Keep your pipe, tobacco, matches and other smoking materials dry in a boat by putting them in a fruit jar suspended under the deck or seat. The lid of the jar is fastened to the underside of a seat, and the jar is removed by unscrewing it.

PART 4

Boats for Sportsmen

Featherweight

An Eight-Foot Duckboat



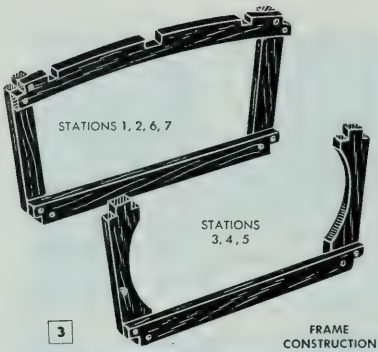
LIGHT ENOUGH to carry on a car or even on your shoulders, this boat will enable you to reach hideaways that are inaccessible with heavier craft. It is sturdy enough to push through dense weed growths and light enough to navigate the shallowest waters. Although only 8 ft. 4 in. long, Featherweight has a capacity of well over 300 pounds. Its construction of ¼-in. waterproof plywood over light pine framing gives it the well-proportioned lines that are shown in Figs. 1 and 2.

Featherweight is built upside down on an erecting frame as shown in Fig. 8. Construction begins with the boat frames, Fig. 4. These are made of ¾-in. (net) pine or other light wood that will not split easily. Full-size patterns drawn on heavy wrapping paper will aid in laying out the pieces to exact size and serve as a guide for assembling them after they are cut. Waterproof glue and No. 8 brass screws are used to join the parts as indicated in Fig. 3. Temporary braces are installed on the open frames 3, 4 and 5.

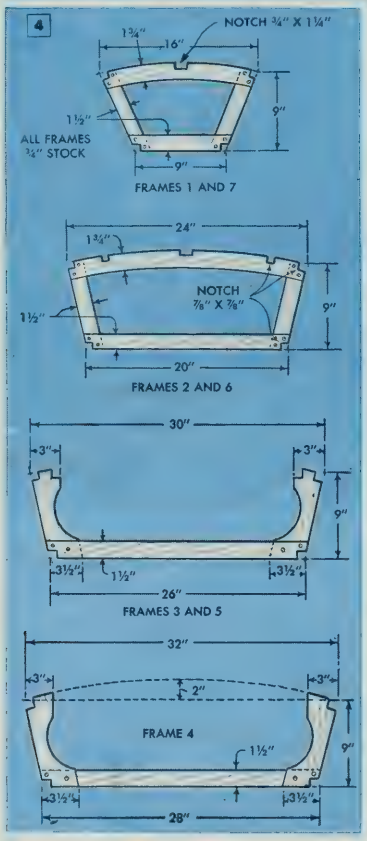
The strongback of the erecting frame, Fig. 11, is made from a 2 x 8-in. plank. A ⅞ x ⅞-in. batten may be used to mark the 2-in. curve. Notches are cut to hold the boat frames in position and the ends are

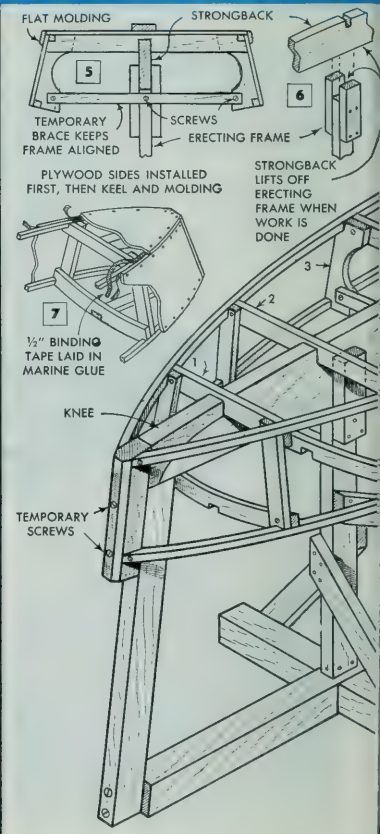
shaped to take a bow and stern knee as shown in Fig. 10. Almost any type of bracing on the erecting frame will be satisfactory provided it is rigid and does not interfere with the work. The framing lumber should be well-seasoned so it will not warp and cause the boat to become lopsided. The perspective view, Fig. 8, shows the entire assembly in full detail. Note in Fig. 6 that the framing is built so that the strongback can be lifted off with the boat frame when the work is completed in this position. When assembling the frames on the strongback be sure the uprights, or side members of the frames, are on opposite sides of their cross members, beginning amidships as shown in Fig. 8. The temporary brace on the No. 4 frame is screwed to the erecting frame as in Fig. 5 to keep it squared and centered. The other frames are held in place by toenailing at the sides of the strongback. Care should be taken to locate the nails where they can be removed easily after the sides and bottom are put on. With the frames in place, the boat stems, one of which is detailed in Fig. 9, are temporarily screwed to the erecting frame as in Fig. 11. Both stems should be about 12 in. long to permit trimming to exact size later.

To install the sheer battens, temporarily nail them in the notches of the No. 4 frame. Then bend the ends of the battens around



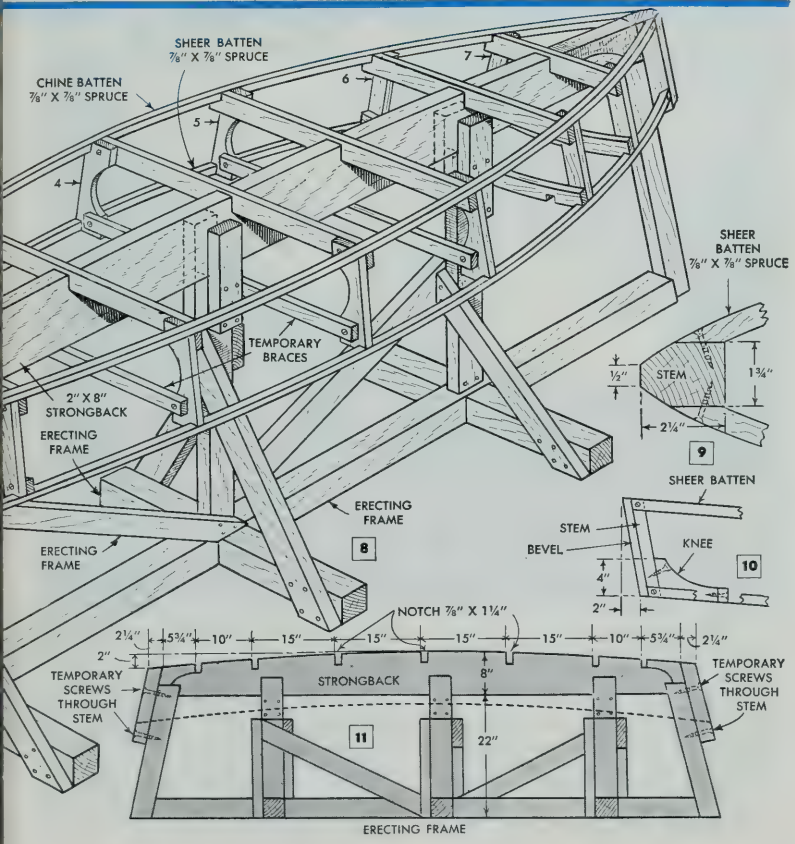
to the stems and mark so they will fit just back of the bevels as indicated in Fig. 9. After cutting to size, install the battens permanently with screws and waterproof glue. Fasten them to frame No. 4 first, and then work progressively toward the stems, securing both sides alternately. Check all the frames for squareness before fastening the sheer battens. Chine battens are installed in the same way. To assure a watertight hull, screws must be countersunk and the battens planed flush with the frames. The plywood covering must be in snug contact with the sheer and chine battens and bevels of the stems. To install the sides, bend and

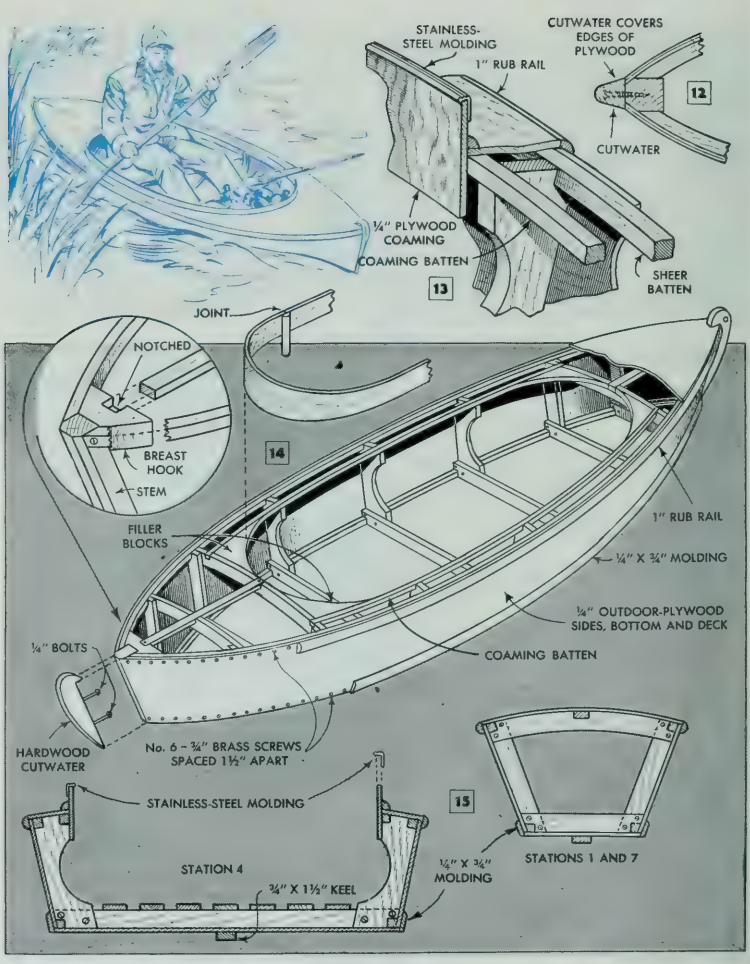




clamp a panel of plywood around the entire side of the frame and mark it along the sheer, chine and stem. Then remove and saw outside of the lines to allow for trim. Cotton binding tape, ½ in. wide, is laid in marine glue applied to the battens, stems and side panels as in Fig. 7. The sides are nailed temporarily to the frame amidships and screwed alternately each way from this point to the stems. Care should be taken to prevent the binding tape from shifting. After the edges of the side pieces have been planed flush with the chine batten, lay on the bottom panel of plywood and mark it for sawing. This is installed in the same manner as the sides. With the bottom finished, set the keel and fasten with 2-in. No. 10 galvanized screws to the frames and knees. To cover the edge of the bottom plywood, as well as the screwheads in the sides, install flat, wood moldings at the chine lines as indicated in Fig. 15. The temporary screws in the stems are then removed, and the hull, together with the strongback, lifted off the erecting frame and placed right side up on saw horses.

The strongback will have to be sawed in half to get it out of the hull. A false bottom or floor as shown at station 4, Fig. 15, should be made an individual unit so it can be removed to clean the bilge. Deck beams, extending from the cockpit to breasthooks fitted in the bow and stern, are installed in the notches cut in the upper members

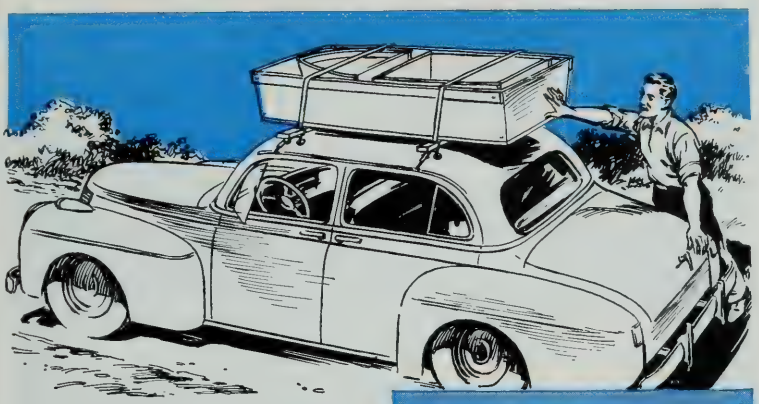




of the fore and aft frames as indicated in Fig. 14. Coaming battens and filler blocks are then added to support the deck and plywood coaming around the cockpit.

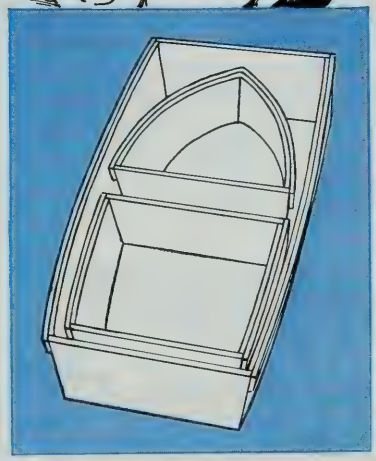
The entire deck may be cut from a single panel of plywood with the cockpit area sawed out, or, if too awkward to handle in one sheet, it can be made from two pieces and joined at the No. 4 frame. Plywood is also used for the coaming, which is made in four sections and joined with a reinforcing strip at frames 3 and 5. A stainless-steel molding as shown in Fig. 13 will protect the top edge of the coaming. To make a watertight joint with the deck, lay a quarter-round molding in marine glue and fit it as snugly as possible in the corner. Hardwood cutwaters at the bow and stern as in Fig. 12 and rub rails along the sheer lines complete the boat.

For an inconspicuous finish, paint the boat a cattail green both inside and outside. Then follow with two coats of spar varnish. Allow time between coats.



3-SECTION ROWBOAT

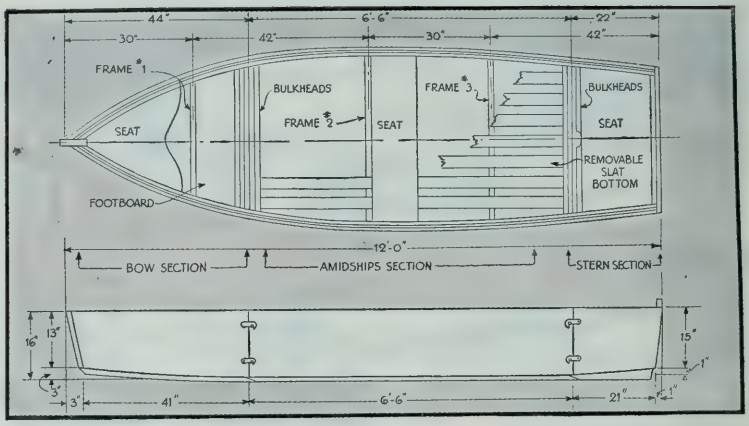
Fits Your Car

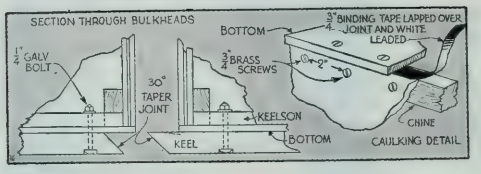


WHEN the three sections are taken apart and nested, this 12-ft. rowboat occupies a space only 6½ ft. long, and by virtue of its thin plywood construction is so light that one man can easily stow it on top of his car, using a suitable cradle to hold it. The boat is designed along standard lines, and construction differs only in the use of ⅜-in. plywood for sides and bottom. In fact, it is built up as a single-unit rowboat, and then sawed between the two double bulkheads to form the three sections.

It is highly advisable to use waterproof plywood, if it is available. If not, the ordinary grade can be satisfactorily waterproofed by giving it three or four coats of paint or shellac, taking care to work it well into the exposed edges. If the wood is not thoroughly waterproofed, moisture will loosen the thin layers of wood and ruin the boat. In fact, all parts, whether directly exposed to the water or not, should be given two coats of paint or shellac before assembling them, and at least two more coats after assembling. Screws, also, should be seated in white lead. When not in use, the boat should be given an application of paint more frequently than an ordinary boat.

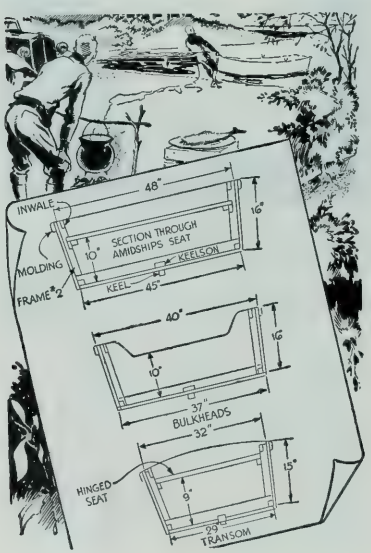
First build the stem. Four wedge-shaped pieces are screwed to a central section of ¾-in. pine having grain at right angles. The stem is fastened to a knee and keelson by means of galvanized carriage bolts, with heads countersunk. Next make the frames Nos. 1, 2 and 3, and the bulkheads. Note that there is a frame on each bulkhead. All frames are notched for chines, keelson and inwale, and frames Nos. 2 and 3 for the seat rail. The bulkheads should not be notched. In assembly, the keelson will be in three sections. Fasten the frames, bulkheads, stem and transoms to the keelson in their relative positions with galvanized or brass screws, and nail the keelson, with assembled frames, etc., temporarily to a plank in order to hold it rigid while installing the chine and inwale. Strips should

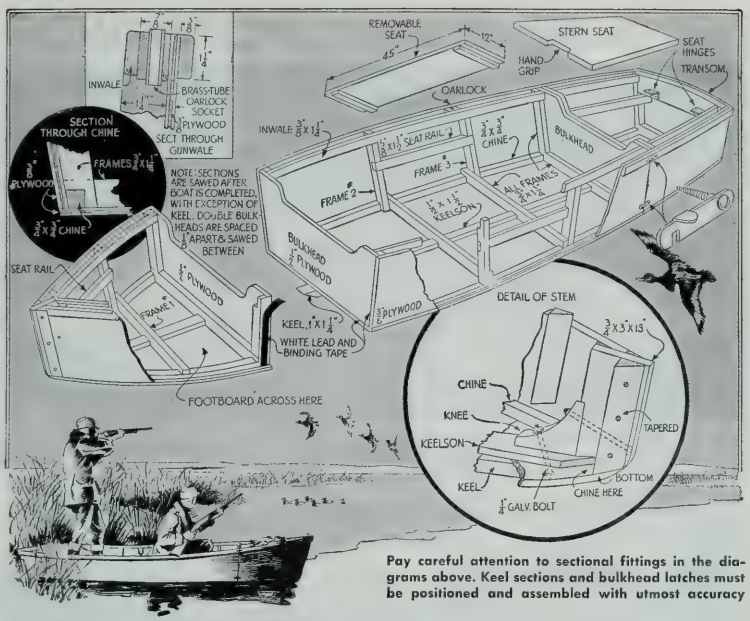




be nailed across the tops of the frames, just below the inwale notches, to hold them in position, and removed after the side boards are on. The bulkheads, of ½-in. plywood, should be located about ⅛ in. apart so that a saw can be inserted for separating the sections.

After the plywood side boards are on, turn the boat upside down for putting on the bottom. This is cut from a single sheet of plywood. The panel is nailed temporarily to the bottom and the outline marked. It is then removed, sawed, and replaced with a finishing nail here and there after a strip of binding tape has been laid over the joint and soaked in white lead. Bear in mind that the edge of the side board and chine must be smoothed with plane or sandpaper to make a flush and even joint. Fasten with ¾-in. brass screws set about 2 in. apart. This will make an absolutely watertight joint. Bulkhead joints should be made the same way. In making the oarlock, a piece of brass tubing is driven into a hole bored in a block that is fastened between side board and inwale. The tube, of course, should be large enough for the shank of the oarlock to turn freely, and should fit tightly in the wood block. The keel is bolted on after the hull sections have been sawed apart. This is necessary because of the tapered joints of the keel which lock the sections against an up-and-down motion. Bolts should be used only near the joints, and then through the keelson. Use galvanized carriage bolts with heads countersunk slightly in the keel. Elsewhere use long screws up through keel, keelson and into crossframes.





Pay careful attention to sectional fittings in the diagrams above. Keel sections and bulkhead latches must be positioned and assembled with utmost accuracy

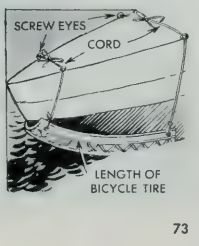
The seat rails are screwed to the frames in bow and stern sections, as shown above. The bow seat is screwed down, but the stern seat is hinged and forms a locker for fishing tackle, lunch, etc., out of the hot sun. The rowing seat is removable, which is necessary for nesting the bow and stern sections. A false bottom should be made for the amidships section to provide dry footing and protect the bottom of the boat.

Anchor Chain Helps Diver Climb Into Boat From Water

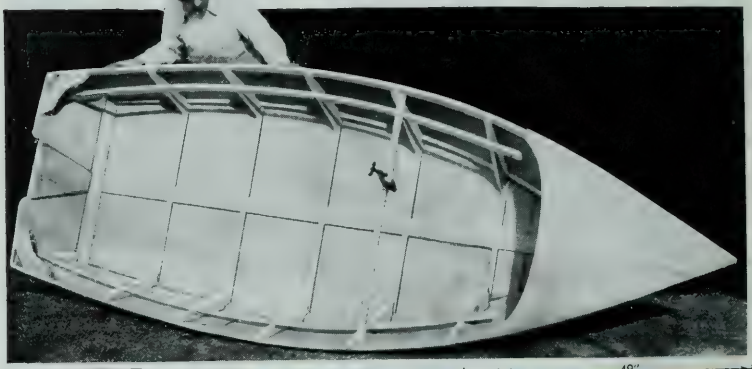
When using a rowboat as a diving platform, difficulty in getting into the boat from the water can be overcome by using the anchor chain as a step. The step can be made any height desired by using a screw hook to fasten it as indicated. A length of garden hose slipped over the chain will provide a cushion for the feet.

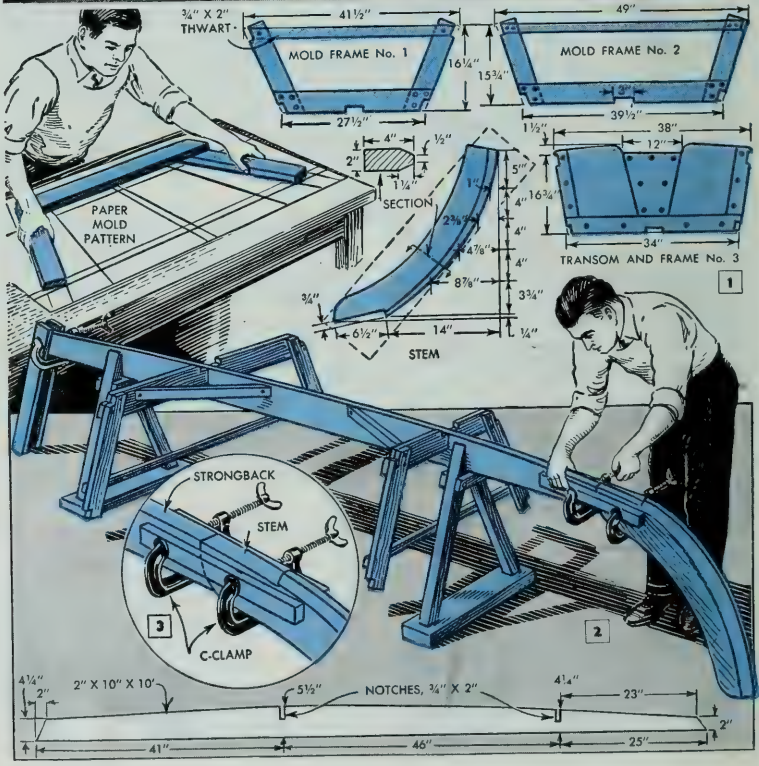
Bicycle Tire Serves as Boat Guard

Prevent damage to the bow of a small boat in shallow water by making a guard of a 1-ft. length of bicycle tire. Attach cords to each end and fasten to screw eyes mounted on the boat deck.



11½-Ft. PLYWOOD



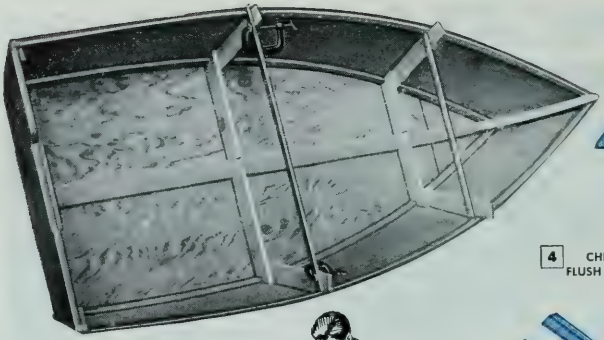


ROWBOAT *Carried on Car Top*

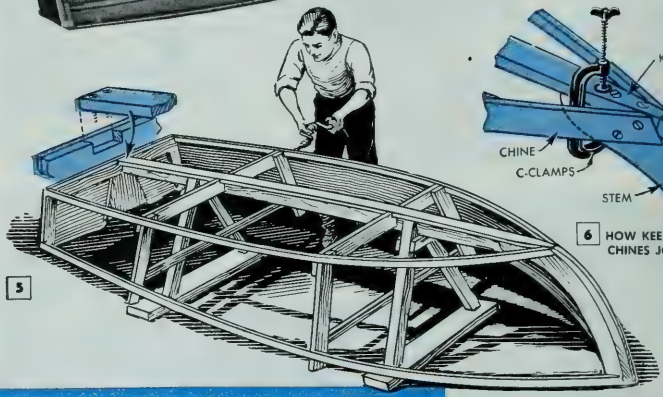
IF YOU CAN use a saw, hammer and plane, you can easily master the construction of this simple car-top rowboat. There are no tricky planks to fit and no difficult rabbet to cut in the stem. Not counting the transom, only two mold frames are required, Fig. 1, and as the molds are only temporary, their assembly is not too important other than seeing that they are put together squarely. To assure this, make a full-size paper pattern of each mold and assemble the pieces directly on the patterns. The transom is ¾-in. plywood. A notched frame is glued and screwed permanently to the inside face of the transom.

Next, the transom, molds and stem are fastened to a strongback or building board. This is cut from a plank, as indicated, and is supported in the manner shown in Fig. 2. The stem is clamped to the strongback as in Fig. 3 and the transom is clamped to two scrap boards which are clamped at an angle to the opposite end of the strongback, Fig. 11. The molds are leveled laterally and braced at right angles to the strongback.

Fig. 5 gives a general idea of how the keelson, chines and sheer battens are fitted. These parts simply rest in the notches of the molds and are fastened only to the stem and transom. The keelson and chines are fastened to the stem as in Fig. 6, using 1¾-in. No. 8 flat-head brass screws. One screw is used to fasten each aft end of the chines and sheer battens to the transom.

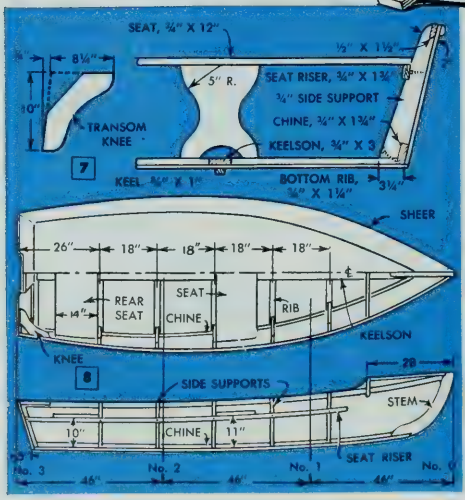


4 CHINE AND SIDE FAIRED FLUSH WITH FRAME BOTTOM



6 HOW KEELSON AND CHINES JOIN STEM

5



The framework is now ready to be covered with marine plywood. Apply the sides first by clamping the plywood temporarily in place and marking it a little oversize for sawing. To make a watertight joint along the chine, coat it with marine glue and lay muslin tape in the glue. Then apply a second coat to the tape and attach the plywood with 1-in. No. 8 flathead screws, spaced 2 in. apart. When dry, plane off the chine and plywood flush with the bottom of the molds as in Fig. 4. For the sake of economy, the plywood bottom can be applied in two or more pieces, Fig. 12, using copper clinch nails along a cleat-backed joint. The exposed edges of the plywood at the stem are faired into the curve of the stem, then coated with marine glue and covered with a strip of half-

MATERIAL LIST

Lumber:

Waterproof plywood

1 pc. ¼ x 48 in. x 10 ft.—Bottom
1 pc. ¼ x 48 in. x 12 ft.—Sides
1 pc. ¼ x 36 x 36 in.—Deck
1 pc. ¾ x 18 x 48 in.—Transom

Spruce, fir, cypress or yellow pine

1 pc. ¾ x 6 x 30 in.—Deck beam
1 pc. ¾ x 3 in. x 10 ft.—Keelson
1 pc. ¾ x 1 in. x 10 ft.—Keel
2 pcs. ¾ x 1¾ in. x 12 ft.—Chines
2 pcs. ½ x 1½ in. x 12 ft.—Sheer battens
1 pc. ¾ x 3 in. x 6 ft.—Transom frame
2 pcs. ¾ x 3¼ in. x 8 ft.—Side supports
2 pcs. ¾ x 1⅜ in. x 10 ft.—Bottom ribs
2 pcs. ¾ x 1 in. x 12 ft.—Molding

Redwood, spruce

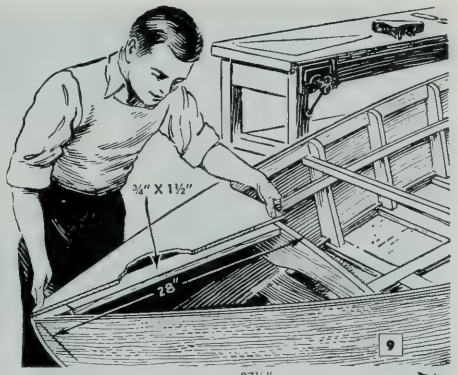
1 pc. ¾ x 14 x 48 in.—Rear seat
1 pc. ¾ x 12 x 48 in.—Forward seat

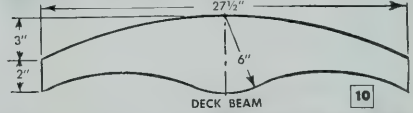
Oak, ash or yellow pine

1 pc. 2 x 8 x 30 in.—Stem
1 pc. ½ x 1 x 24 in.—Stem molding
1 pc. 1 x 10 x 18 in.—Transom knees
1 pc. 1¾ x 5¾ in. x 10 ft.—Building board
2 pcs. ¾ x 3¾ in. x 8 ft.—Scrap stock frames

Hardware:

4 gross 1-in. No. 8 flat-head brass screws
1 gross 1¼-in. No. 8 flat-head screws
3 doz. 1¾-in. No. 8 flat-head screws
1 lb. 1¼-in. galvanized shingle nails
1 pr. oarlocks
3 brass lifting handles
1 mooring eyebolt
½ pt. marine or phenol-resin glue
Muslin tape
Paint and varnish

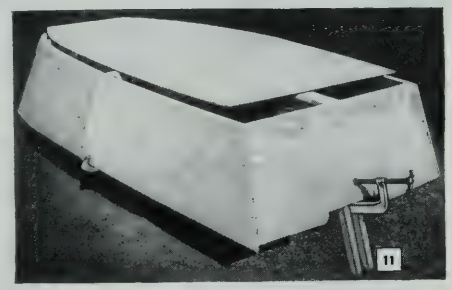


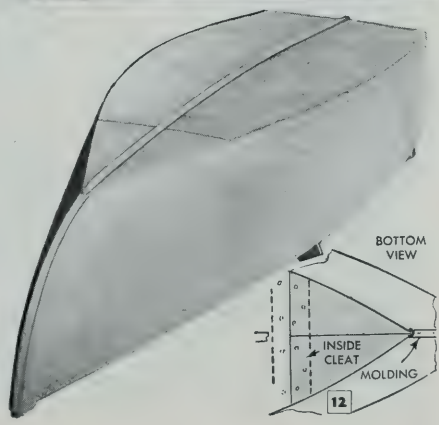


round molding to meet the keel.

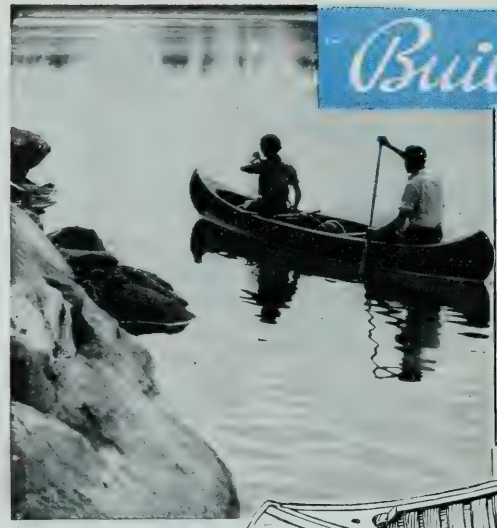
Now, lift the boat from the strongback, but before removing the molds, place a temporary cross brace between the sheer battens to maintain shape until the seats are installed. Complete the deck as shown in Fig. 9, fitting a deck beam, Fig. 10, 28 in. from the stem. Five supports are fitted to each side of the boat on the inside at points indicated in Fig. 8. These are notched to fit over the chines and sheer battens as shown in the sectional view, Fig. 7. This step is followed by installing the ribs which are notched to straddle the side supports and simply butt against the keelson and chines. Copper or other rust-resistant nails are used to fasten the ribs to the plywood, the nails being clinched on the inside. Complete the boat by adding the transom knees, seat risers, seats, keel and the half-round sheer molding.

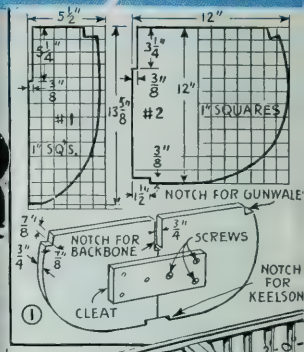
Use a copper bottom paint on the bottom of the boat and coat the rest of the wood above the water line with a lead-and-oil primer paint. Then finish with two full-bodied coats of deck enamel. A mooring eyebolt and three brass sash lifts screwed to the top edge of the transom provide convenient hooks for lashing the boat securely with rope to the car bumpers.

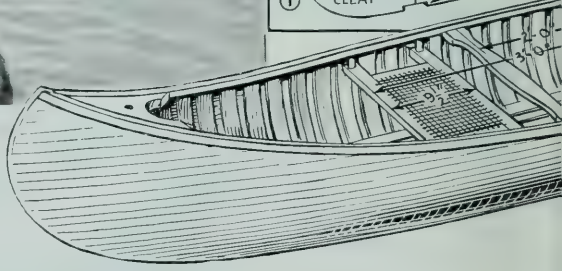




Build Your







WITH its low ends and flat bottom, which extends well up into bow and stern, this 16-ft. Canadian-type canoe is well-adapted to the needs of the sportsman. It features steadiness on the water and ease of paddling. The craft is little affected by cross winds on account of its wide beam, which is 33 in., amidships.

Construction begins with a temporary framework consisting of a set of molds and a backbone, to which the molds are fastened. Paper patterns are made from the squared drawings, Figs. 1 and 2, to trace the outline of the molds on the stock. Each mold is made in two halves, fastened together temporarily with cleats. As both ends of the canoe are identical, two molds of each size, with the exception of the center one, are required. The backbone is a piece of ¾-in. stock 5¼ in. wide and 14 ft. 6 in. long on the upper edge and 14 ft. 4½ in. on the lower edge. See Figs. 3 and 7. The keelson is a piece of clear, straight-grained ash or oak, cut as shown in Fig. 7.

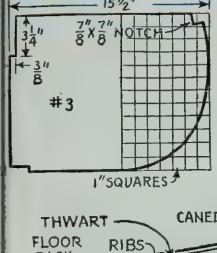
The stems are built up from regular stock as in Fig. 6. The grain should run nearly at right angles as in Fig. 7, and casein glue and dowels should be used in the joint.

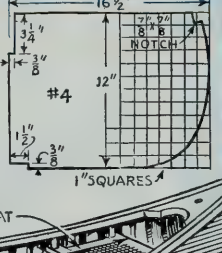
Assembly is started by locating and nailing the molds in position along the backbone, as in Figs. 3 and 7. The frame is then turned over and the keelson nailed temporarily to each of the molds, after which the stem pieces are screwed between the cleats at the ends of the backbone, Fig. 7.

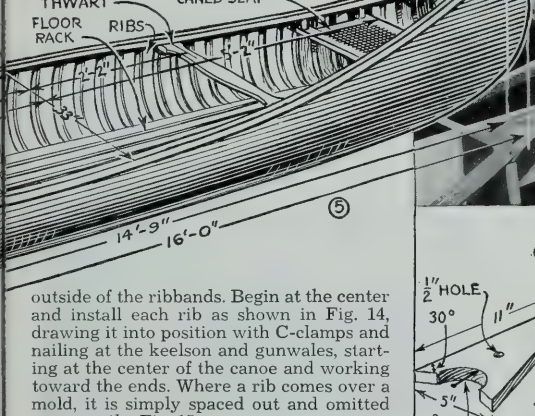
The ends of the keelson are bent down to meet the stem pieces, where they are fastened permanently with brass screws and bolts as indicated. The gunwales running from stem to stem are made of straight-grained ash. They should be wrapped with rags and soaked with hot water until they become pliable. The ends are beveled and fastened permanently to the stem pieces with nails. The installation of the decks, Figs. 5 and 6, greatly strengthens the framework and aids in drawing the gunwales to shape. The decks are fastened with brass screws as in Fig. 4. Now, four ribbands, equally spaced and reaching from stem to stem, are screwed to the molds on each side of the keelson as shown in Figs. 8 and 9.

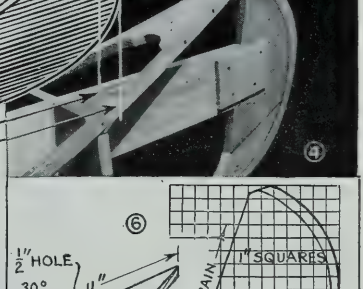
Steaming, Fig. 13, is necessary to make the ribs sufficiently pliable to take the bends. Each rib should be long enough to reach from gunwale to gunwale over the

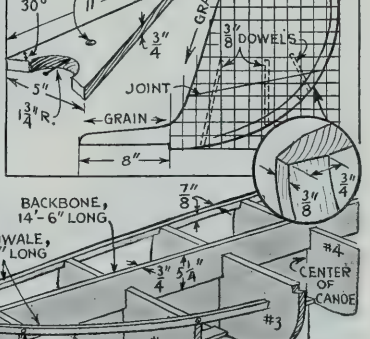
Own CANOE







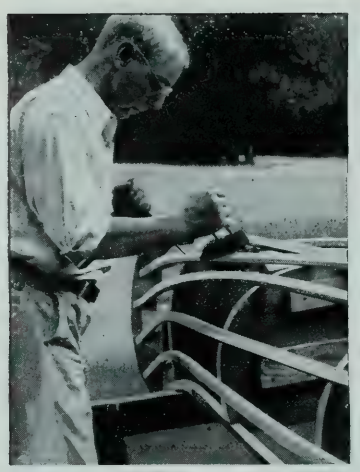


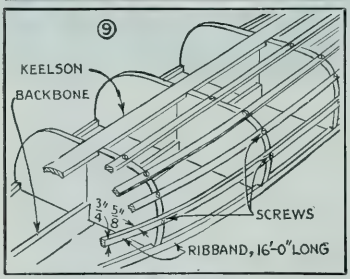


outside of the ribbands. Begin at the center and install each rib as shown in Fig. 14, drawing it into position with C-clamps and nailing at the keelson and gunwales, starting at the center of the canoe and working toward the ends. Where a rib comes over a mold, it is simply spaced out and omitted temporarily, Fig. 15.

When the ribs are all in place, the ribbands are taken off, making the job ready for the ⅛-in. cedar planking. If your bandsaw is equipped with a ripping fence you will be able to save money on the ribs and planking by resawing them yourself, Fig. 10. The planks are soaked for several hours, then the first full-length plank is laid with the edge parallel with the center line of the keelson, Fig. 11, using clamps to draw it into place. Copper nails are used for fastening the planking to the ribs and all nails must be clinched across the grain on the inside of the ribs, Fig. 12. Fig. 11 shows the arrangement of the planking.

To remove the backbone, take out the



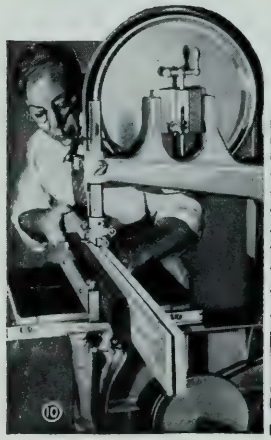


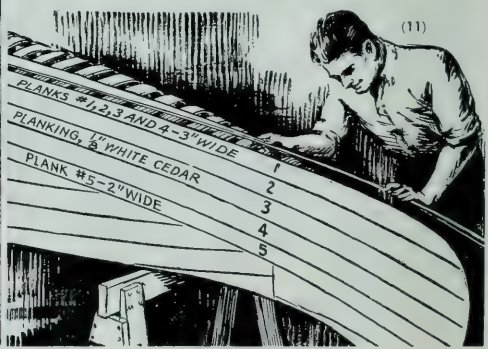
cleats and saw it through at the center. Take out all but the No. 3 molds. Bolt the maple thwarts, Figs. 5 and 16, to the underside of the gunwales to prevent the hull from springing out of shape. The seat frames, Figs. 5 and 18, also may be fitted at this time. The rear stretchers are bolted directly to the gunwales but the two forward are lowered 3 in. by means of hardwood spacers as in Fig. 18.

For canvasing you need two pieces of 8-oz. canvas, long enough to reach from stem to stem with about a foot to spare, and wide enough to reach from the gunwale to the keel with allowance for a lap. Start by spreading the canvas over half of the canoe, tacking temporarily near the center of the gunwale. Pull the covering tightly around the bilge and place a few tacks along the keel, near the center. Wet the canvas and pull it lengthwise over the stems, and tack. As it dries, the fabric will tighten and take the shape of the hull. When dry, pull out the tacks at one end and fit the canvas neatly around the stem, from the point of the keel to the gunwale, lapping 1 in. over the stem. Fasten with ¾-in. copper tacks, spaced 1 in. apart. Then remove all other temporary tacks and roll the canvas back off the canoe.

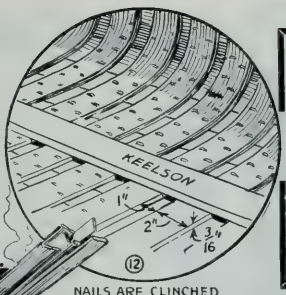
Beginning at the tacked end, apply a coat of waterproof canvas cement to a section of the planking along the keel. Do not cover a large area as the cement dries quickly. Unroll the canvas over the cemented area, pull tightly lengthwise and fasten the loose end temporarily while tacks are placed closely along the gunwale and keel of the cemented portion. As you tack be sure that the cloth lies flat without any wrinkles. Then squeegee the canvas with the palm of the hand to make sure that it is in contact with the cement at all points. Now, trim the canvas along the gunwales and fasten with copper tacks, spaced about ½ in.

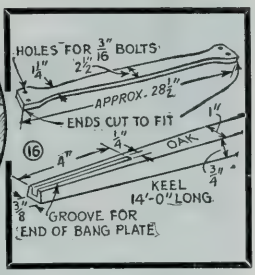
Allow a few days for drying, then apply a coat of canvas cement. When dry, sand

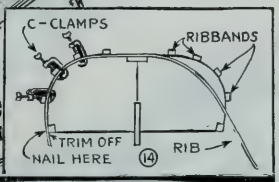


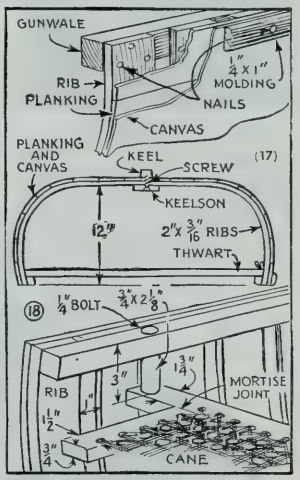


smooth and finish with one coat of deck paint and one of flat color after which it is again sanded and varnished. Apply the gunwale molding, Figs. 17 and 19, with roundhead brass nails, and finish the canoe inside and out with two coats of spar varnish. Finally the keel is varnished





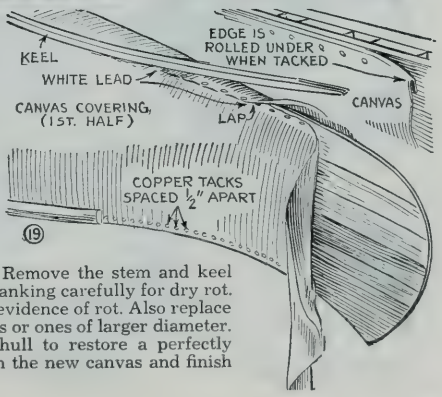




separately and screwed in place as in Fig. 19. Finish up with the ¼-in. half-round copper bang plates.

In varnishing the inside of the canoe, care should be taken to prevent the varnish from "piling up" in the corners between the ribs and planking. Check up on these points and spread out such spots with a brush before the varnish begins to dry.

You can keep your canoe in good condition for years by proper attention to the hull whenever the canvas covering must be replaced. Remove the stem and keel with the old canvas, and check the planking carefully for dry rot. Replace any plank or rib that shows evidence of rot. Also replace loose nails or screws with longer ones or ones of larger diameter. Finally, plane and sandpaper the hull to restore a perfectly smooth, curved surface. Then put on the new canvas and finish as you did the first covering.



Build "BANTA"

IF YOU want a lightweight utility boat with a nice turn of speed and easy handling, build "Banta." A boat like this has a lot to recommend it—simple, inexpensive construction, a one-man weight of less than 150 lbs., practically leakproof—she's a smooth, easy sailer on any man's river. Good for rough water, too. The V-bottom of Banta makes her a much better rough-water boat than conventional flat-bottom plywood construction. She'll ride 'em!

Making the frames: Make the frames first, using oak, elm, pine or mahogany. Draw each frame care-

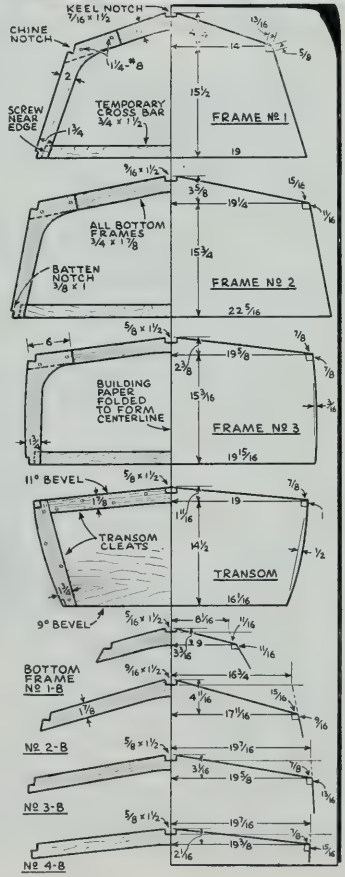
"Banta"	
Length	12'
Beam	45"
Depth amidship	19"
Weight	150 lbs.
Passengers	3
Motor	2-10 HP.
Speed	8-25 M.P.H.

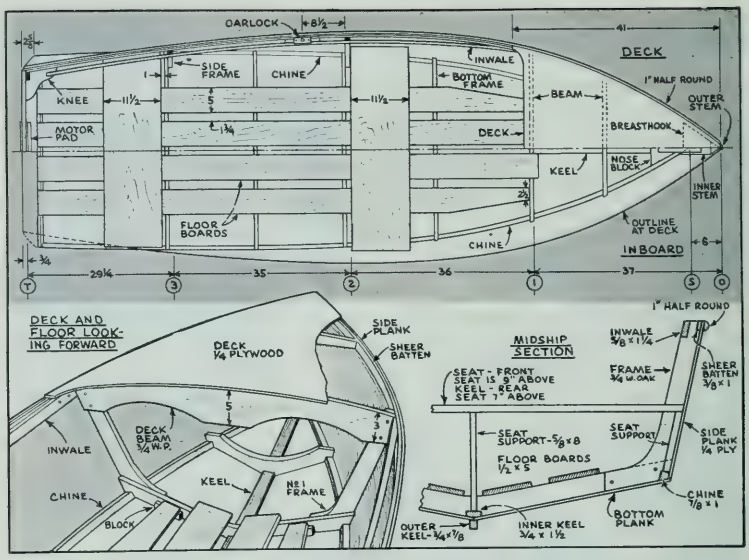
12-ft. Plywood Outboard

fully on a piece of building paper and make the assembly over this after cutting the parts to shape on the bandsaw. The side frames are curved out at the bottom to produce a good landing on the bottom frames. An optional method of construction is to butt the side and bottom frames together and tie them with ¼-in. plywood gussets on either side. The transom is bandsawed from ¾-in. marine plywood to the dimensions given. It is cleated at the edges and bottom with the frame stock. The transom is raked 9 deg., which amounts to 2⅝ in. in the height given.

Frame assembly: Banta is built upside down on a building platform, as shown in the drawing. On the surface of the platform, run in a pencil centerline and mark the station lines. Cleats fastened parallel to the station lines as shown will provide a support and locate each of the main frames. The keel is now fastened to the frames and transom, checking carefully to maintain each frame true and square with the building platform. The stem is a triangular piece of white oak, mounted at the extreme nose of the building platform at an angle of 67 deg. It is a good idea to make a full-size drawing of the assembly at the stem since this will show exact lengths, angles, etc. As can be seen in the stem detail and section drawings, the forward end of the keel fastens to a nose block, the nose block being held to the stem by a knee. The chines go on easily, the assembly at the stem being to either side of the nose block. All joints are screw-fastened. The carriage-bolt fastenings at the stem are not put in until the boat is complete. It will be noted in the drawing that the forward ends of chines and keel are saw-kerfed. This makes bending easier and also helps to maintain a full curve. The kerfs can be cut on the bandsaw, ⅛ in. deep and 1 in. apart for the chines, and 3/16 in. deep x 1½ in. apart on the keel. All frames must be beveled to carry out a smooth line, and the keel and chines are planed down to come flush with the frame shape. The sheer batten goes on without much trouble, being let into the stem. The whole frame assembly should be made dry and is knocked down and reassembled with cold resin glue after fitting.

Planking: Planking for Banta is ¼-in. fir plywood of the waterproof, resin-bonded type. Two standard 4 x 12-ft. sheets are required. One sheet will make the two side planks, while the other sheet will cut the two bottom planks and the deck. The side planks are applied first. Fitting is quite simple since the half sheet of plywood can be bent to the frames and held with clamps while the shape is being marked with a pencil. The planks are cut off square at the stem to provide a flat of about ¾ in. on which to land the outer stem piece. The bottom





planks are butted together at the keel and extend over the side planks. All fitting should be done dry, after which the permanent assembly can be made with cold resin glue. The outer keel is V-cut on a circular saw to fit the angle of the bottom planking.

Floor and deck: The fitting of floor boards is quite simple and clearly shown in the drawings. The deck is ¼-in. marine plywood bent to a crown of about 2 in. The main deck beam is spanned across frame No. 1. There is an intermediate deck beam about 15 in. forward of this, and a breasthook at the extreme forward position behind the stem. Notches are cut on the inner edge of No. 2 and No. 3 side frames to take the inwales. At frame No. 1 the inwale is beveled slightly and fastened directly to the sheer batten. At the transom the inwales are let into wooden knees. Seats are spanned across the hull and butt against the planking. Each seat is supported with a riser at the center and end risers extending down to the chines at either end.

Finishing: A first coat of special plywood sealer and primer should be applied. This will prevent hairline checking and the showing of the ridges of the grain structure, which fir has a tendency to do even under two or three coats of paint. The hull may then be finished in clear varnish to retain the natural grain, or given thin coats of enamel finish in the color desired. Sand each coat lightly.

MATERIAL LIST

- 3 pieces oak, elm, mahogany or white pine, ¾ x 8 in. x 8 ft.—for frames
- 1 piece waterproof fir or mahogany marine plywood, ¾ x 17 x 39 in.—for transom
- 1 piece oak, pine, spruce or yellow pine, ¾ x 1½ in. x 11 ft.—for inner keel
- 1 piece oak or yellow pine, ¾ x ⅞ in. x 11 ft.—for outer keel
- 2 pieces pine, oak or mahogany, ⅞ x 1 in. x 12 ft.—for chines
- 2 pieces oak or mahogany, ⅜ x 1 in. x 12 ft.—for sheer battens
- 1 piece oak, ⅞ x 5 x 6 in.—for nose block
- 1 piece oak, 1½ x 5 x 8 in.—for stem knee
- 2 pieces waterproof fir or mahogany marine plywood, ¼ in. x 4 x 12 ft.—for planking
- 1 piece waterproof fir or mahogany marine plywood—for deck. This item will be cut from planking stock on sheet used for bottom planking
- 1 piece white pine or spruce, ¾ x 8 in. x 4 ft.—for deck beams
- 1 piece white oak or yellow pine, 1¼ x 5 x 8 in.—for breasthook
- 2 pieces oak, yellow pine or mahogany, ⅝ x 1¼ in. x 9 ft.—for inwales
- 1 piece oak or yellow pine, 1¾ x 2 x 18 in.—for inner stem
- 1 piece oak or yellow pine, ¾ x 2 x 18 in.—for outer stem
- 4 pieces white pine, cypress or redwood, ½ x 5 in. x 9 ft.—for floor boards
- 1 piece white pine or mahogany, ¾ x 12 in. x 8 ft.—for seats
- 1 piece white pine, ¾ x 8 in. x 4 ft.—for seat supports
- 2 pieces fir plywood, ¼ x 5 x 12 in.—for motor pads. This item can be cut from planking stock
- 1 piece yellow pine or white oak, 1¼ x 8 x 8 in.—for transom knees
- 2 pieces yellow pine or white pine, 1 in. half round x 12 ft.—for sheer molding

PART 5

"Zephyr"--

a 14-ft. Sailing Dinghy

ZEPHYR -

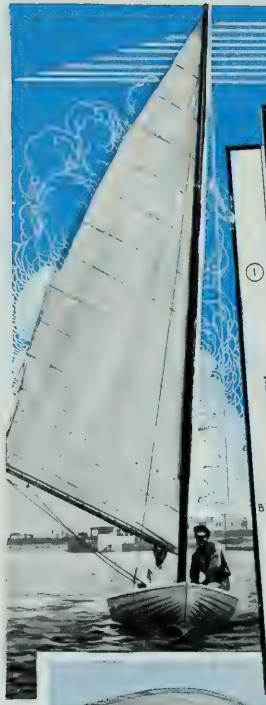
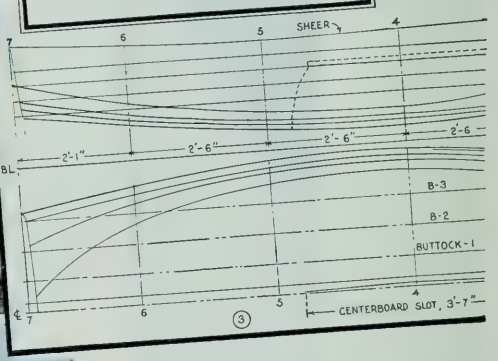


TABLE OF OFFSETS

Dimensions in Feet—Inches—Eighth inches

	HEIGHTS ABOVE BASELINE						
Station	1	2	3	4	5	6	7
Sheer	2 11-1	2-8-5	2-6-2	2-4-1	2-1-5	2-4-1	2-5-5
Buttock 1	1-5-4	0-10-7	0-8-0 +	0-7-2	0-8-2	0-11-1	1-3-2
B—2	——	1-3-0	0-9-6 +	0-8-2	0-9-2	1-0-2	1-4-7 +
B—1	——	——	1-2-1	0-10-2	0-10-7	1-2-7	1-9-2
Rabbet	1-0-2	0-9-3	0-7-2	0-6-5 +	0-7-5	0-10-2	1-2-2
Keel	0-11-0	0-8-5	0-6-7	0-6-2 +	0-7-2	0-9-7	1-1-0 +

	HALF-BREADTHS						
Sheer	0-10-7 *	1-7-7	2-3-1	2-6-6 +	2-6-3	2-3-1	1-10-0
WL—1	0-3-4	1-0-1	1-8-4	2-2-1	2-2-1	1-6-2	——
WL—2	0-6-3 +	1-3-4	1-11-4	2-4-4 +	2-4-6	1-11-5	1-2-3
WL—3	0-8-3	1-5-3 +	1-11-3	2-6-0	2-6-0	2-2-2	1-8-5
WL—4	0-9-3	1-6-5	2-2-2	2-6-4	2-6-3	2-3-0	1-9-6

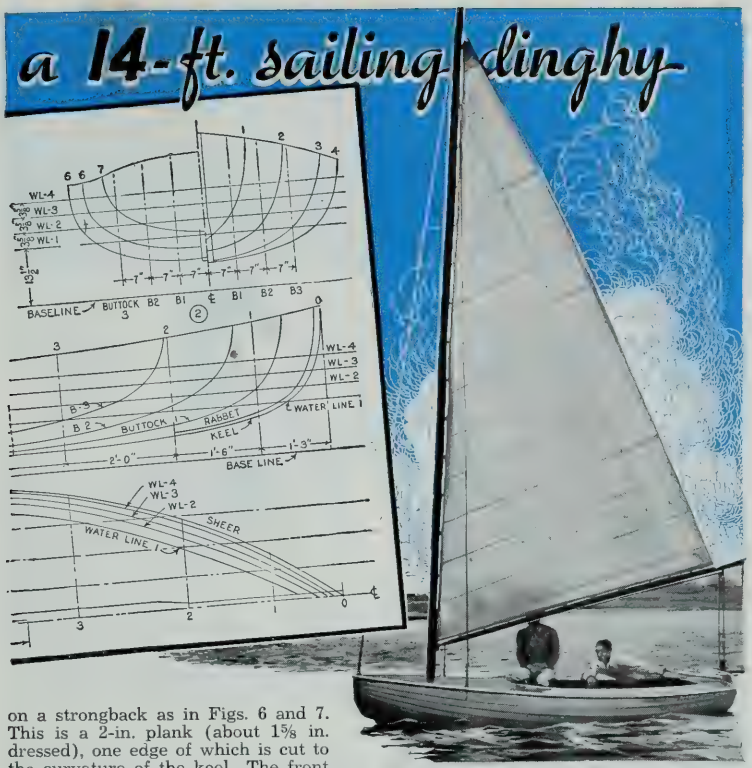


THIS fleet 14-ft. boat combines strength with light weight, and is easily maneuvered. It carries 140 sq. ft. of canvas and weighs about 350 lbs.

A table of offsets, Fig. 1, enables you to lay out exact patterns for temporary frames, on which the boat is built. The patterns for the frames are drawn on heavy paper ruled off in 1 or 2-in. squares as in Fig. 9. Dimensions in the table of offsets are from the centerline and base line to the outside of the planked boat. Therefore the curves for the frames should be drawn ⅜ in. inside of the curves obtained from the table of offsets, as the planking used on this boat is ⅜ in. thick. Fig. 9 shows how the patterns for the frames are drawn, but the curves should not be drawn from these sketches, as they will not give the accurate results that you will get by laying them out from the table of offsets. From Figs. 1, 2 and 3, you will be able to locate the points along which the curves are drawn.

After cutting the frames from wide pieces of 1-in. soft pine, assemble them

a 14-ft. sailing dinghy



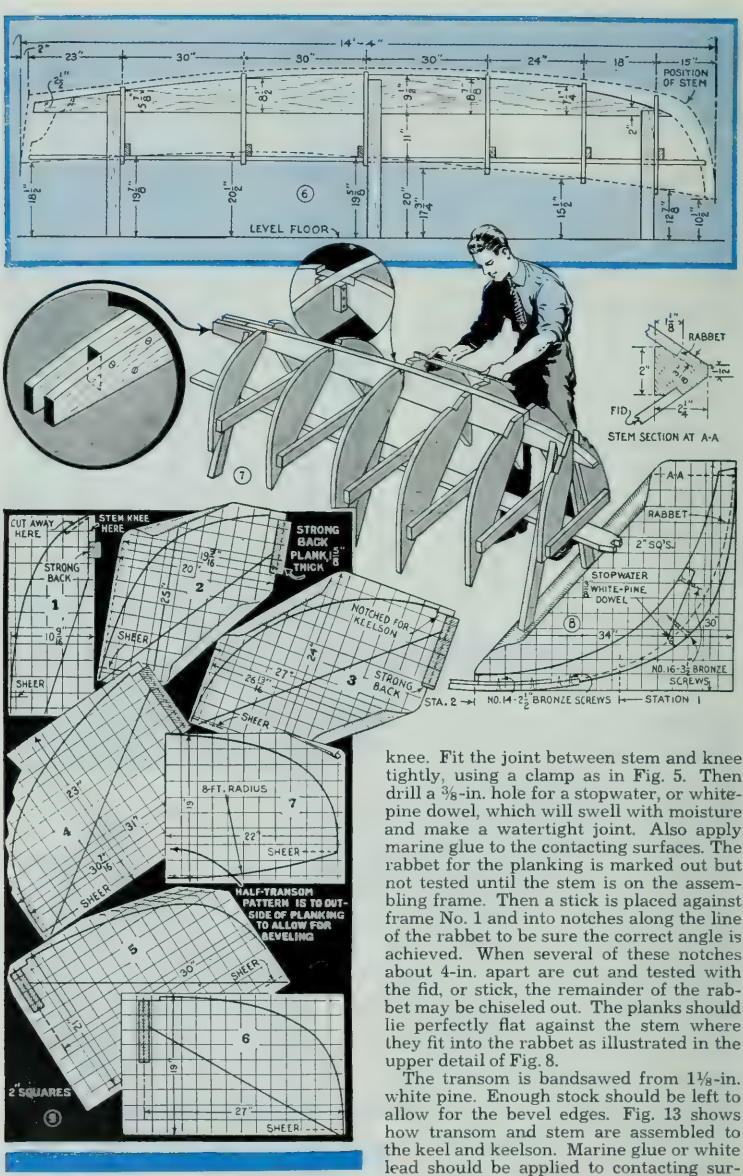
on a strongback as in Figs. 6 and 7. This is a 2-in. plank (about 1⅝ in. dressed), one edge of which is cut to the curvature of the keel. The front end of the strongback is cut away to receive the stem knee, and the transom knee fits between two pieces at the after end. A board which runs below the strongback is notched for the stem. Bevel the edges of the frames to conform with the curvature of the hull. The bevel is determined by testing with a straight batten about ½ in. thick. In building any boat the frames must be so beveled or faired off—that is, planed to a natural curve. If one frame has a hump so that the batten does not touch the adjoining frames, fair the offending member down.

Each pair of frames is notched for the ½ by 4-in. keelson. At the forward ends, where the planks will have a pronounced bend, it may be necessary to notch or flatten the frame for a plank or two, but this should be done after the garboard (plank next to the keel) and adjoining plank have been laid out.

The stem, Fig. 8, is bandsawed from 2-in. mahogany or white oak, and is assembled with the

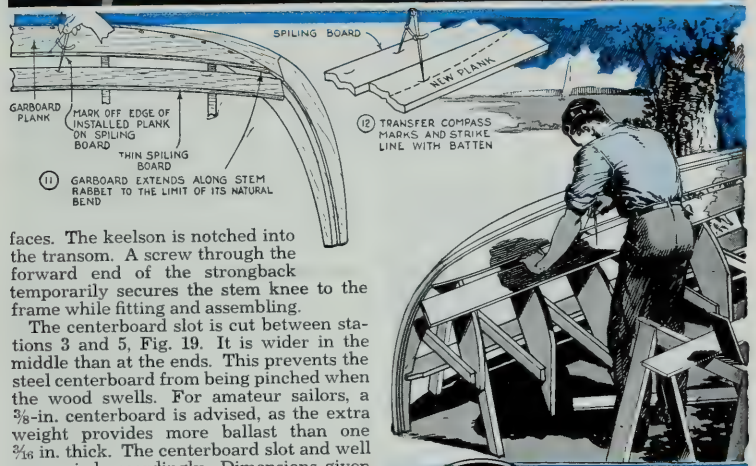
ZEPHYR

Length over all	**14 ft. 4 in.**
Length at water line	**13 ft. 8 in.**
Beam	**5 ft. 2 in.**
Draft	**7 in.**
Freeboard for'd	**2 ft. 0 in.**
Freeboard aft	**1 ft. 4 in.**



knee. Fit the joint between stem and knee tightly, using a clamp as in Fig. 5. Then drill a ⅜-in. hole for a stopwater, or white-pine dowel, which will swell with moisture and make a watertight joint. Also apply marine glue to the contacting surfaces. The rabbet for the planking is marked out but not tested until the stem is on the assembling frame. Then a stick is placed against frame No. 1 and into notches along the line of the rabbet to be sure the correct angle is achieved. When several of these notches about 4-in. apart are cut and tested with the fid, or stick, the remainder of the rabbet may be chiseled out. The planks should lie perfectly flat against the stem where they fit into the rabbet as illustrated in the upper detail of Fig. 8.

The transom is bandsawed from 1⅛-in. white pine. Enough stock should be left to allow for the bevel edges. Fig. 13 shows how transom and stem are assembled to the keel and keelson. Marine glue or white lead should be applied to contacting sur-

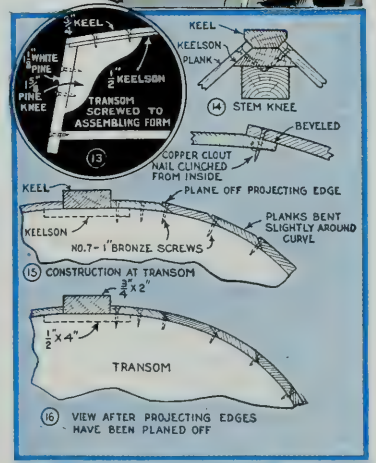


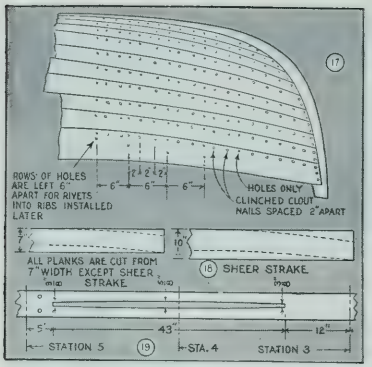
faces. The keelson is notched into the transom. A screw through the forward end of the strongback temporarily secures the stem knee to the frame while fitting and assembling.

The centerboard slot is cut between stations 3 and 5, Fig. 19. It is wider in the middle than at the ends. This prevents the steel centerboard from being pinched when the wood swells. For amateur sailors, a $\frac{3}{8}$-in. centerboard is advised, as the extra weight provides more ballast than one $\frac{3}{16}$ in. thick. The centerboard slot and well are varied accordingly. Dimensions given here are intended for a $\frac{3}{16}$-in. centerboard, but if you change to a $\frac{3}{8}$-in. thickness be sure to increase the space to accommodate it ($\frac{3}{16}$ in. wider slot than given in the drawings).

Screws through keelson to keel are placed on each side of the slot. Elsewhere the screws run along the centerline of the keel. These screws should be spaced so they will not interfere with other screws to be installed through the ribs after the entire hull is planked and has been removed from the form. The ribs are to be spaced 6 in. on centers, beginning at the bottom of the transom.

Now for planking. The garboard, or plank alongside the keel comes first. The shape of this can be laid out with a spiling board, as in Figs. 11 and 12. Bring the plank as far forward on the stem knee as possible without twisting or straining unduly. A mistake many amateurs make is in not doing this, with the result that all following planks must assume a pronounced curve. When the plank is fitted so that it lies snugly against keel and in the stem





rabbet, remove and apply marine glue. This is applied along keelson, keel and stem rabbet, and then the plank is drawn down with ¾-in. No. 6 bronze wood screws, heads countersunk just enough to putty over later. Install one garboard, then the other, and proceed in this manner through the entire planking job. If planks are all screwed down on one side before beginning the other, it imposes a strain which might pull the hull out of shape.

With garboards installed, spile for adjoining planks. They are lapped ¾ in., Fig. 14. The edge of the garboard is beveled where the succeeding plank overlaps it. Mark the garboard where the next plank should come. Apply marine glue and drill holes 2 in. apart for copper clout nails, which should be a snug fit. The ends are placed on an iron bar and bent back into the wood. Amidships, the curve of the frames is not so pronounced and the garboard lies flat on the keelson. Near the stem, however, the keelson as well as keel is beveled along the rabbet, becoming more pronounced near the rabbet in the stem. As the planks approach the transom and stem, the overlap gradually disappears into a beveled butt joint as shown in Figs. 15 and 16. Some builders flatten the rounded profile of the transom to take care of the flat plank ends, but a nicely rounded effect can be achieved on this hull simply by trimming out the underside of the plank end slightly concave. This permits the plank to fit more closely to the edge of the transom, and with very slight bending will follow the curve of the latter. Take plenty of time and be accurate as the watertight qualities of a hull depend upon this work.

Note the pleasing, gentle curve of the sheer strake from Fig. 18. In drilling the holes for the clout nails 2 in. apart as in Fig. 17, leave them out every 6 in. for rib rivets. The completed hull, Figs. 4 and 10, may now be lifted off the form. The inside is painted before installing the ribs.

Ribs and Beams

With the hull removed from the assembling form and the inside of the boat completely painted, you are ready to bend to shape and install the oak ribs. Block up the hull on a pair of saw horses and nail two or three temporary thwarts or cleats across the gunwales, as in Figs. 20 and 21. Small finishing nails driven part way into the sheer strakes will be sufficient to hold these, as the ribs, when installed, exert little outward pressure.

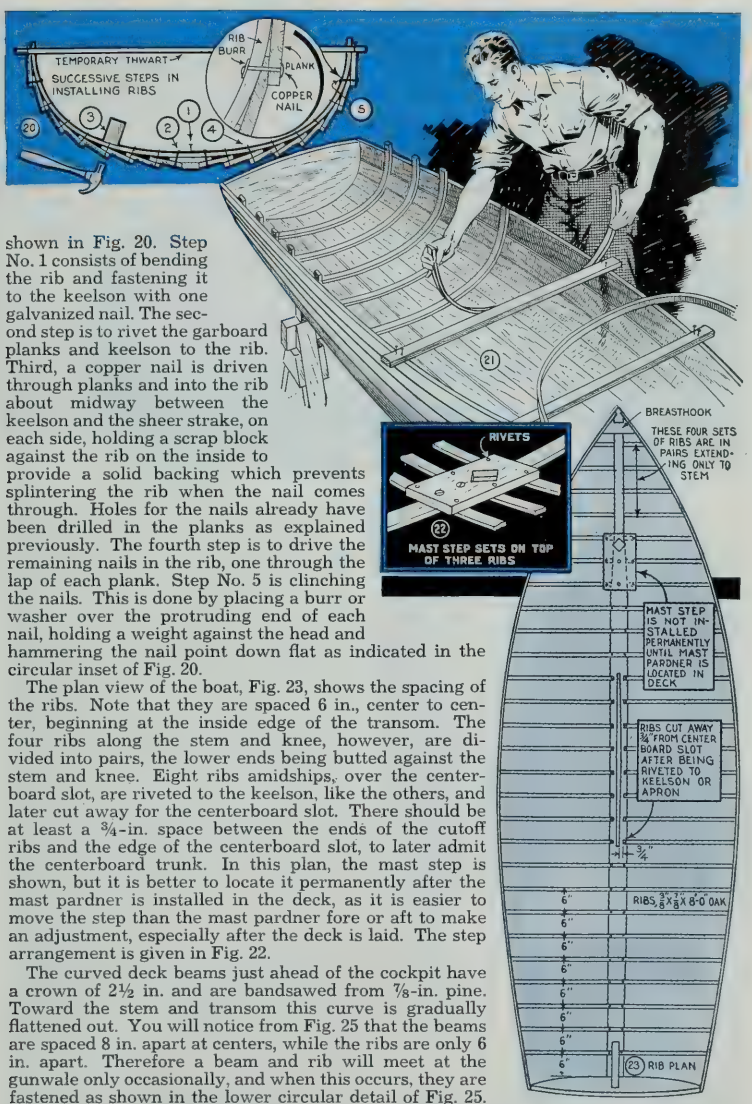
Before the ribs can be bent, they must be steamed for about 20 min. This can be done in a long, narrow tank, or in an iron pipe, capped at the lower end and nearly full of water. The pipe is supported at an angle, with the lower end resting in a fire pit dug in the ground. The ⅜ x ⅞-in. oak ribs, when thoroughly steamed, will become flexible. In selecting the stock for these, see that the grain runs straight.

The procedure for fitting each rib is

MATERIAL LIST

All dimensions net—does not include stock for temporary frames and strongback

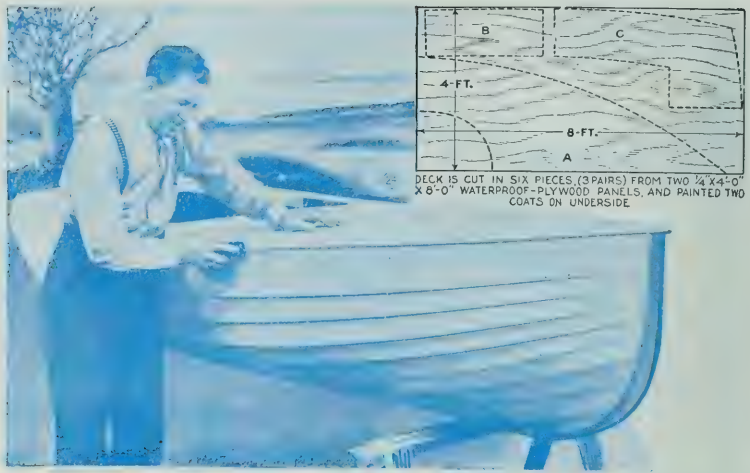
1 piece 2 x 8 in. x 4 ft.—mahogany or oak for stem
1 piece ½ x 4 in. x 14 ft.—pine or oak for keelson
1 piece ¾ x 2 in. x 14 ft.—oak for keel
1 piece 1⅛ x 17 in. x 4 ft.—white pine for transom
1 piece 1⅛ x 14 in. x 4 ft.—white pine for C-board box
16 pieces ⅜ x 7 in. x 16 ft.—vertical grain spruce for planking
2 pieces ⅜ x 10 in. x 16 ft.—vertical grain spruce for planking (sheer strakes)
27 pieces ⅜ x ⅞ in. x 8 ft.—oak for bent frames
1 piece ⅞ x 12 in. x 18 ft.—pine for deck beams
2 pieces ¼ x 48 in. x 8 ft.—waterproof plywood for deck
2 pieces 1¼ in. x 16 ft. half-round—mahogany for rub rails
1 piece 1¼ in. x 4 ft. half-round—mahogany for transom molding
1 piece ⅞ x 10 in. x 5½ ft.—pine for seat
1 piece ½ x 4 in. x 16 ft.—mahogany for coaming
1 piece 3 x 3 in. x 28 ft.—spruce for mast
1 piece No. 10, 6 x 15 ft.—canvas for deck
11 pieces ⅜ x 2½ in. x 8 ft.—white pine or spruce for floor boards
1 piece 3/16 to ⅜ x 18 x 50 in. boiler plate, galvanized for centerboard (see text for thickness of centerboard)
Bronze or galvanized hardware. screws, marine glue, candle wicking, paint, putty, etc.

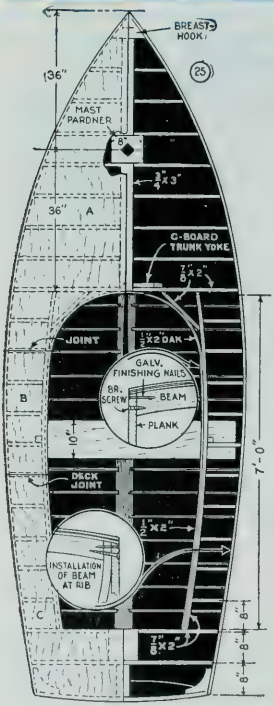


shown in Fig. 20. Step No. 1 consists of bending the rib and fastening it to the keelson with one galvanized nail. The second step is to rivet the garboard planks and keelson to the rib. Third, a copper nail is driven through planks and into the rib about midway between the keelson and the sheer strake, on each side, holding a scrap block against the rib on the inside to provide a solid backing which prevents splintering the rib when the nail comes through. Holes for the nails already have been drilled in the planks as explained previously. The fourth step is to drive the remaining nails in the rib, one through the lap of each plank. Step No. 5 is clinching the nails. This is done by placing a burr or washer over the protruding end of each nail, holding a weight against the head and hammering the nail point down flat as indicated in the circular inset of Fig. 20.

The plan view of the boat, Fig. 23, shows the spacing of the ribs. Note that they are spaced 6 in., center to center, beginning at the inside edge of the transom. The four ribs along the stem and knee, however, are divided into pairs, the lower ends being butted against the stem and knee. Eight ribs amidships, over the centerboard slot, are riveted to the keelson, like the others, and later cut away for the centerboard slot. There should be at least a ¾-in. space between the ends of the cutoff ribs and the edge of the centerboard slot, to later admit the centerboard trunk. In this plan, the mast step is shown, but it is better to locate it permanently after the mast pardner is installed in the deck, as it is easier to move the step than the mast pardner fore or aft to make an adjustment, especially after the deck is laid. The step arrangement is given in Fig. 22.

The curved deck beams just ahead of the cockpit have a crown of 2½ in. and are bandsawed from ⅞-in. pine. Toward the stem and transom this curve is gradually flattened out. You will notice from Fig. 25 that the beams are spaced 8 in. apart at centers, while the ribs are only 6 in. apart. Therefore a beam and rib will meet at the gunwale only occasionally, and when this occurs, they are fastened as shown in the lower circular detail of Fig. 25. In this case, a galvanized finishing nail and a bronze screw are used at each joint, the nailhead being covered later with the rub rail. The seat is supported at the ends by cleats fitted across three ribs. Short uprights to brace the edge of the cockpit are shown in Fig. 27. The center of the seat is supported by the end of the centerboard trunk.

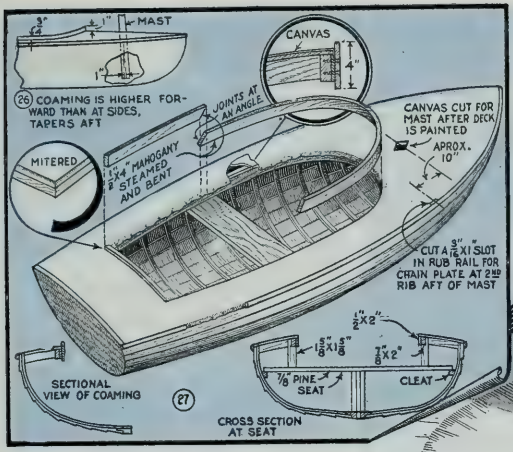




Referring to the deck plan, Fig. 25, you will note a double frame on each side of the cockpit. The outer one is of ⅞-in. pine, while the inner one, forward of the seat, is ½-in. oak, steamed and bent. Aft of the seat, the ½-in. piece is merely a filler and can be of pine. A breasthook is installed at the stem, and knees are fitted at the transom, also shown in Fig. 25. The mast pardner is permanently located between two deck beams, approximately midway between the stem and forward end of the cockpit.

The plywood deck panels A, B and C, Fig. 25, are three separate pieces on each side, with the joints centered on the beams and on battens recessed in the beams along the centerline of the deck. The plywood, which should be the waterproof kind, is brought to the outer edge of the planking and the inner edge of the cockpit. The six pieces are bandsawed from two 4 x 8-ft. panels of ¼-in. plywood. In cutting, allow about ⅛ in. for planing flush, Fig. 24. The detail of Fig. 24 shows how the plywood sheets are laid out for cutting. Paint the beams and the underside of the plywood pieces before nailing them to the deck with galvanized finishing nails.

While it would be somewhat more convenient to fit the centerboard trunk before installing the beams, it can be done afterward. In either case, be sure that the lower edges of the side boards follow the same curve as the keelson and fit perfectly, as most sailboats develop leaks at this point. Make a template of plywood to lay out the curve, and then fit it to the keelson. The sides of the trunk must be notched in about ¼ in. for the ends of the ribs. The notching helps to prevent the ribs from coming loose if the bottom should receive a severe bump. In the side, sectional view, Fig. 32, note that the ends of the separators fit down into the ends of the centerboard slot. This special feature of the Zephyr makes a watertight joint. Location of the centerboard pivot bolt is also given in Fig. 32. The



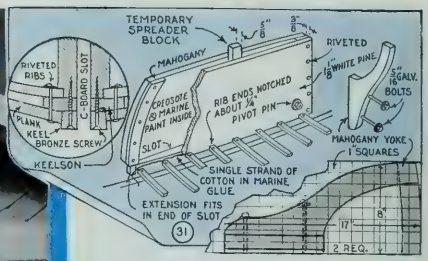
bolt, which should be of bronze, is made watertight by means of rubber washers placed under steel washers. A 5/16-in. centerboard is specified here. However, for beginners, the additional weight provided by a 3/8-in. centerboard helps to prevent capsizing. If the latter size is used, the width of the well will have to be increased accordingly. Fig. 31 shows how the centerboard trunk is fitted to the keelson. A single strand of cotton candle wicking is laid in marine glue, around the slot, and a spreader block is left in the trunk until it is screwed to the keel assembly. Before being put together, the inside of the trunk is painted with creosote and marine paint. The cross-section detail, through the slot, shows how securely the trunk is fastened to the keel unit with long, bronze screws, while Fig. 30 shows how rigidly it is braced at the top by the seat and yoke. Details of the mahogany yoke are given in Fig. 31. The centerboard should be galvanized heavily, especially if the boat is to be sailed in salt water.

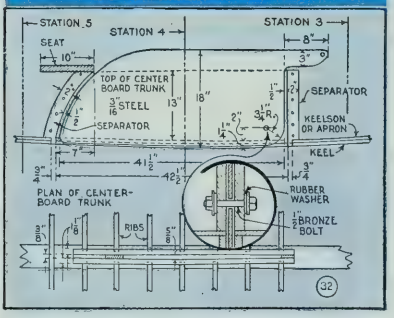
After the plywood has been given two or three coats of paint, and this has dried thoroughly, you cover the entire deck, including the cockpit, with a piece of No. 10 duck canvas, measuring 6 x 15 ft. Stretch the canvas over the deck, copper-tacking it along the gunwales and the transom. Next, block up the hull and walk on the canvas over the cockpit as in Fig. 28, which removes the slack before tacking to the edge of the cockpit. Fig. 29 shows the canvas after being applied. Now, the rub rail and coaming should be installed.

A neat, low coaming is shown in Figs. 26 and 27. This is fastened with oval-head, bronze screws. The coaming projects about 1 in. above the deck in front and tapers down to about ½ in. aft, Fig. 33.

Mast and Rigging

The 24-ft. mast is made next. Eight pieces of ½-in., straight-grained spruce, 2½ in. wide are required to build up the hollow mast as detailed in Fig. 34, four of these pieces being 10 ft. long and four 14 ft. long. The mast runs straight to a point 40 in. from the peak from where it tapers to 2 in. square at the end. The pieces are assembled to form the hollow section by





lapping adjacent edges as shown in the circular detail of Fig. 34, and are spliced together by cutting the ends 45 degrees and then centering the butted ends over filler blocks fitted in place at these joints. Note that the joints are alike on opposite sides. The blocks should measure 2 in. square and 4 in. long, with the exception of those fitted at the base and peak which should be 6 in. long. Assemble the pieces with casein glue and brass screws, and clamp the work perfectly flat while the glue is drying. The aft edge of the mast, you will notice, is planed flat to receive the sail track.

The sheave for the halyard is installed as shown in Fig. 35. It should be either of brass or galvanized iron and should turn in a slot which is at least ⅛ in. wider, so that it will not bind when the wood swells. Eye plates for the stays are screwed to the mast at the beginning of the taper and like all other fittings, they should be of brass, especially for salt-water use. The gooseneck, shown in the insert in Fig. 34, can be made from brass stock or a similar fitting can be purchased ready-made.

For the boom, select a good, straight-grained piece of spruce 1¾ in. square and 12 ft. 6 in. long. Beginning at the center of the piece, taper one end to measure 1⅜ in. square, planing the work on the bottom and sides only, as shown in Fig. 38. The top is left flat for the sail track and the opposite end of the boom is trimmed to fit the gooseneck brackets. Location of the blocks for the sheet and the method of securing the sheet to the end of the boom are also shown in Fig. 38. Quarter-inch hemp rope is used for the sheet.

Locations of the chocks, cleats, stays and traveler are given in Fig. 39. The side stays are screwed to the second rib aft of the mast, which brings them approximately 10

in. behind the center of the mast. The traveler is screwed to the top of the transom. A square, chromium-finished plate is screwed over the mast hole in the deck, and a grommet through which the halyard passes through the deck, Fig. 37, is fitted just above a block installed beneath the deck. Deck cleats are screwed into pieces of stock previously fitted under the deck before it was covered. When the sail is raised, the halyard is belayed to a cleat screwed to the seat, Fig. 37. The side stays are fastened to chain plates with chromium turnbuckles of the pipe type, Fig. 39. The forestay is fastened to the oak stem with an eyebolt as in the circular detail, Fig. 39.

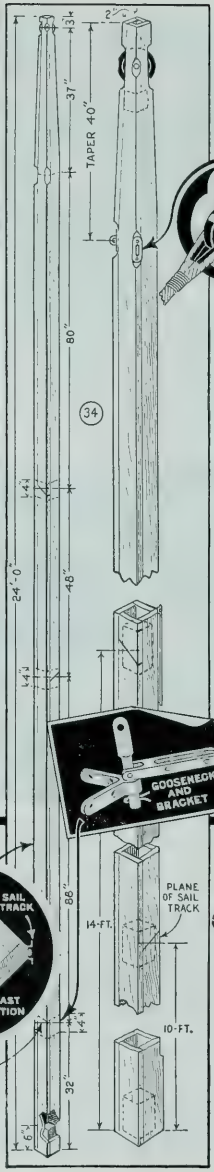
The centerboard is conveniently raised and lowered by means of two blocks fitted as in Fig. 43. An upright, screwed to a deck beam and the keelson, provides a solid support for attaching the block and the end of the line. The other end of the hemp rope is belayed to a cleat on the seat. The rudder, Fig. 36, is cut from a single piece of oak $1\frac{3}{16}$ in. thick. Lay out a full-size pattern on 1-in. squares and transfer to the wood. The edges are tapered, below the water line, as shown in the section A-A. The tiller, which may be made of either mahogany or oak, is located between rabbeted cheeks at the top of the rudder and is bolted in a tapered slot to permit a slight up-and-down movement. Place thin washers on each side of the tiller and be sure that the slot is wide enough to avoid binding when the wood swells. Strap and plate gudgeons, fastened to the rudder and transom, as in Figs. 36 and 39, permit the rudder to be detached easily by means of a removable pin. This type of hinge will not come loose and checks the tendency of the rudder to float upward. The ¾-in. mahogany splash board, Fig. 44, is fastened to the deck with screws, which are inserted in counterbored holes and driven into the deck beams. This is centered forward of the cockpit, just aft of the mast, and is reinforced at the peak with a brass strip.

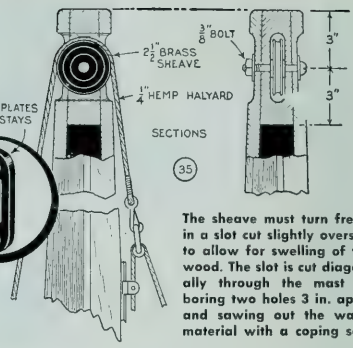
Now for painting the boat. First sand the entire hull thoroughly, using progressively finer grades of paper until the surface is glass smooth. Now, before proceeding further, a water line must be marked on the hull. This is done easily by first blocking up the hull level on a pair of saw horses as in Fig. 42. Referring to the profile view of the hull and the table of offsets given in the first installment, you can locate points A and B, Fig. 45, where the true water line meets the stem and transom. Now, block up the hull horizontally so that

Top photo shows the foot of the sail being tracked on the boom in readiness to be hauled aloft, while the lower photo, a stern view of Zephyr, shows the fast, trim lines of its hull and roominess of the cockpit

each point is 30 in. above a level floor or driveway. At the stem and at the transom erect a trestle as in Fig. 41. The height of points A and B, Fig. 45, must be equal when a 6-in. straightedge is placed across the top. The straightedge must be set level laterally with the hull. Then, as an assistant moves the straightedge across the top of the trestle to bring it in contact with the hull, a pencil can be run along the top of the straightedge to mark the water line. To make a permanent guide line, which is easy to follow with a brush, a pointed tool such as an awl, with the end slightly rounded, can be used to score the wood as in Fig. 40.

The bottom of the hull, below the water line, is given three coats of copper bottom paint, using the type which is expressly prepared for use on boat hulls. This will

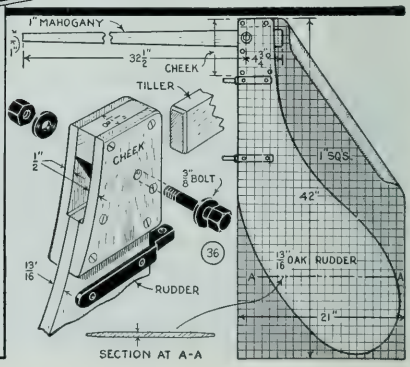


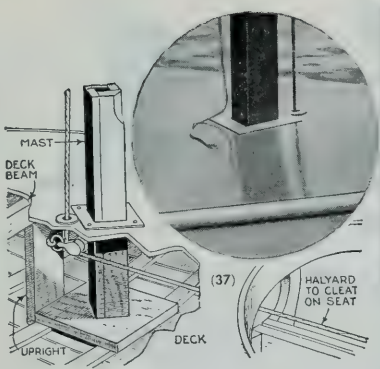


The sheave must turn freely in a slot cut slightly oversize to allow for swelling of the wood. The slot is cut diagonally through the mast by boring two holes 3 in. apart and sawing out the waste material with a coping saw

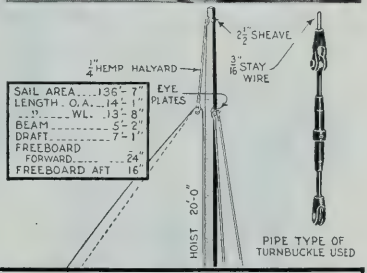
give a smooth, durable finish below the water line. A coat of oil paint is applied to the hull above the water line. After this priming coat is dry, apply four coats of flat white paint, allowing ample time between coats for each to dry thoroughly. Sandpaper this lightly and then apply a final coat of gloss enamel. The deck is given several coats of flat paint to fill the canvas covering, and when dry, is sanded lightly as before. This procedure is repeated until the desired finish is obtained. Sand the mast, boom, tiller and cockpit coaming smoothly and finish with three coats of high-grade spar varnish. If each coat is rubbed lightly with fine steel wool, an excellent surface will be had for the final coat. All fittings should be removed from the mast and boom before varnishing.

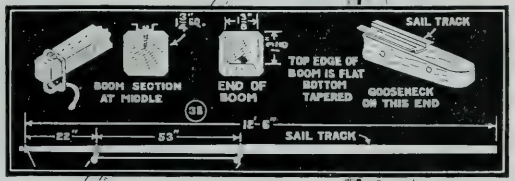
As previously mentioned, the use of a ⅜-in.-thick centerboard is advised for amateur sailors, as the extra weight provides more ballast than a thinner one. More

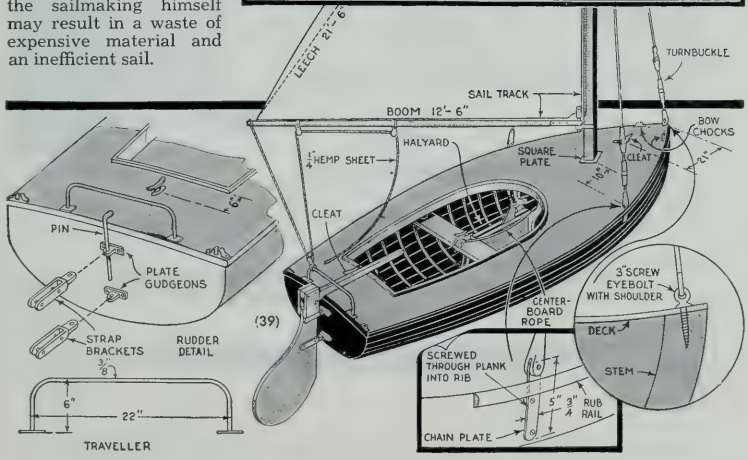




experienced seamen will be able to handle the hull easily when a 7/16-in. centerboard is used. Naturally the width of the centerboard well must be varied accordingly so that the centerboard will not bind when the centerboard slot swells after the boat is launched. Fig. 39 gives full dimensions for the sail. It is best to have this made up by a competent sailmaker. The materials and fittings required are available at any marine-supply store, and all the sailmaker will need are the dimensions given in Fig. 39 in order to turn out a sail that will be fit and serviceable. For the amateur to attempt the sailmaking himself may result in a waste of expensive material and an inefficient sail.





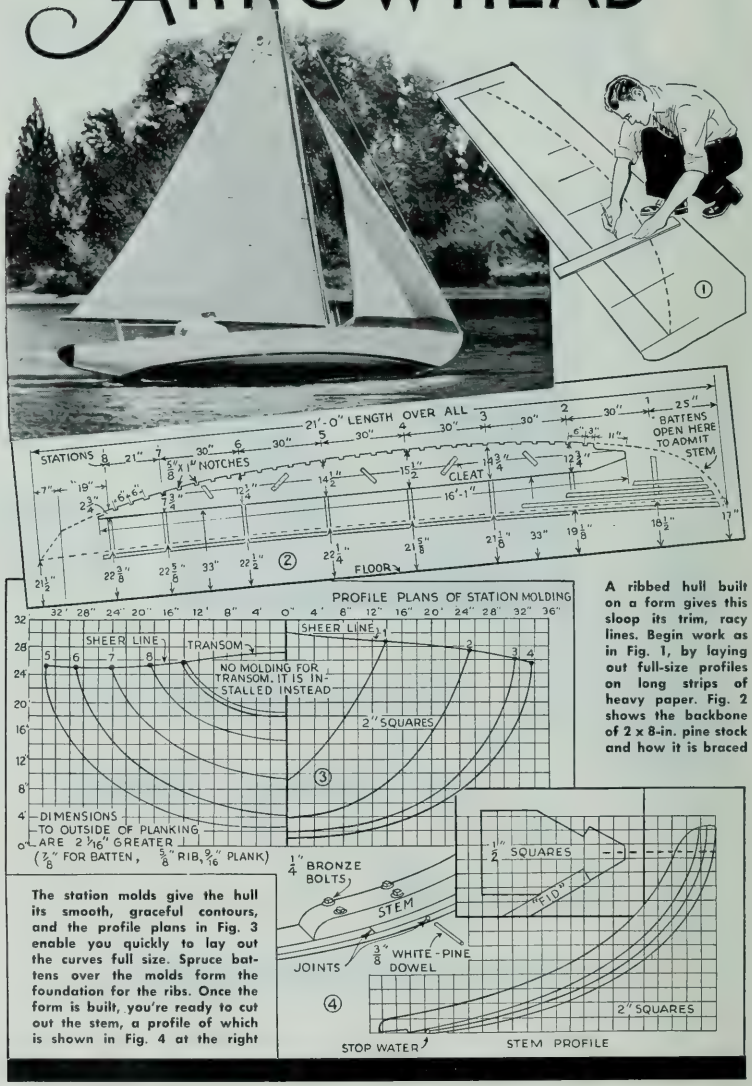



AWL WITH POINT SLIGHTLY ROUNDED
(40)
STRAIGHT-EDGE
(42)
STRAIGHTEDGE MUST BE AT LEAST 6" WIDE
(41)
LAP LINK
YOKE
(43)
DECK BEAM
½" ROPE THROUGH UPRIGHT & KNOTTED
CENTER-BOARD
(44)
BRASS
60°
DECK BEAM
WOOD PLUG
¾" MAHOGANY SPLASH BOARD
RELATIVE POSITION OF SPLASH BOARD
24"
A
TRUE WATER LINE
B
16"
STRAIGHTEDGE
30"
30"
(45)
LEVEL BEAM

PART 6

"Arrowhead"--
a 21-foot Sloop

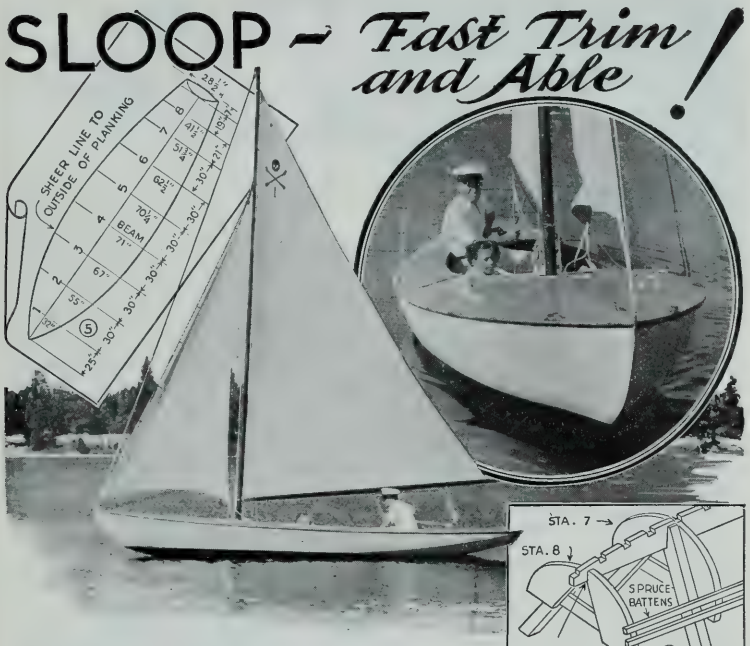
"ARROWHEAD"

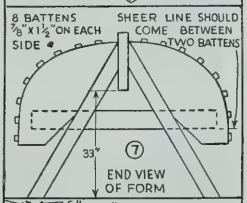


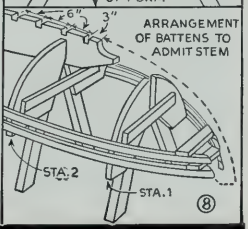
A ribbed hull built on a form gives this sloop its trim, racy lines. Begin work as in Fig. 1, by laying out full-size profiles on long strips of heavy paper. Fig. 2 shows the backbone of 2 x 8-in. pine stock and how it is braced

The station molds give the hull its smooth, graceful contours, and the profile plans in Fig. 3 enable you quickly to lay out the curves full size. Spruce battens over the molds form the foundation for the ribs. Once the form is built, you're ready to cut out the stem, a profile of which is shown in Fig. 4 at the right

SLOOP – *Fast Trim and Able!*



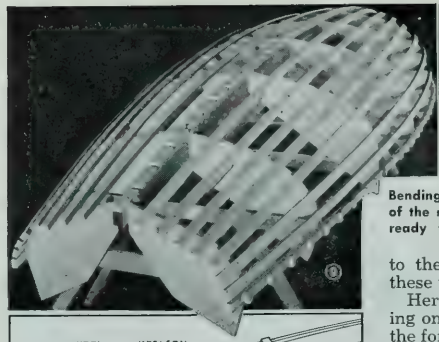


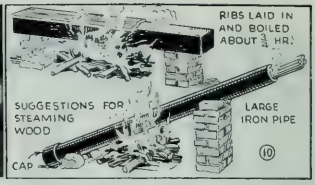


EXCEPTIONALLY fast in light winds and a stanch performer in heavy weather, Arrowhead is especially designed for conditions found on the smaller inland lakes, though she's at home on either salt or fresh water. With a length of 21 ft. and a beam of 5 ft. 11 in. she makes a splendid family boat with room for eight or ten passengers. The hull, moreover, is a particularly suitable type for the amateur boatbuilder because it is built over a form. With the form right, you can't go wrong on the hull. Materials needed for the job are listed on page 117.

First of all, get large sheets of clean, smooth wrapping paper, pasting enough sheets together to lay out the plans full-size as in Figs. 1 and 5. After the plans are drawn, tack the sheet to the floor near your work space so that it will be handy to refer to as you go along. The backbone of the form, Fig. 2, is cut from a piece made up of two 2 x 8-in. planks, cleated together as shown. This is sawed to the curve of the keel and notched every 6 in. to receive the bent ribs, which are installed later in the construction.

Next cut the station molds in pairs from the full-size profiles you have laid out from Fig. 3. These are made in pairs and can be cut from any 1-in. material. Since they do not become a part of the boat, use cheap lumber. Note from the squared diagram that dimensions to the outside



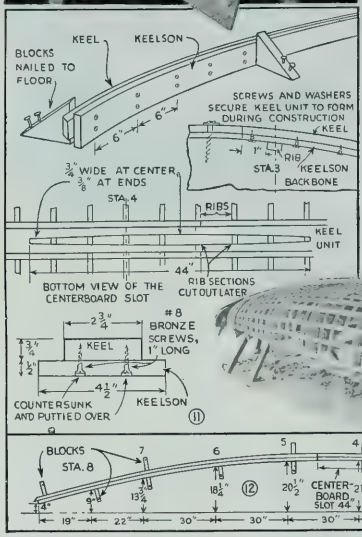


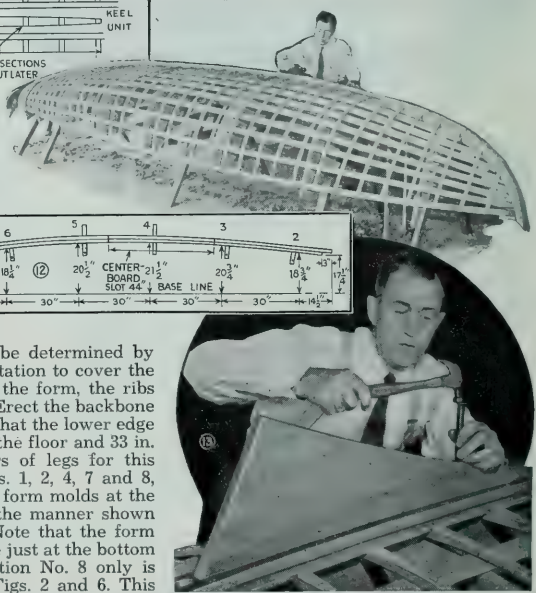
Bending the oak ribs is not difficult if you use either of the methods above. At the left you see the form ready for the construction of the ribs and keel

to the station molds. There are eight of these to a side, equally spaced, as in Fig. 9.

Here is an important point: Before nailing on the battens, mark the sheer line on the form molds. This you get by measuring the distance from the floor as in Fig. 2. Space the two bottom battens so that the line comes between them. The forward ends of the battens do not meet at the stem, as a space must be left here to admit the stem piece, as in Figs. 8 and 15. Station No. 1 has a similar gap.

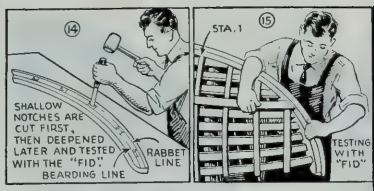
The keel is built up of two members, the true keel and the keelson, as in Fig. 11. Both parts should be oak, bent to the same





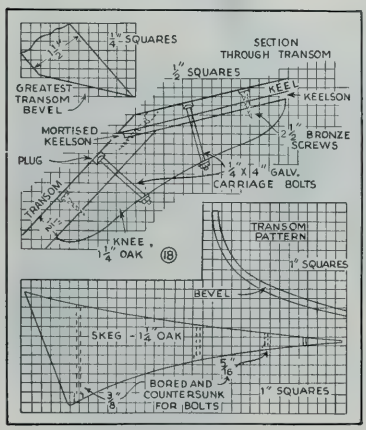
of the planking are to be determined by adding 2 1/16 in. at each station to cover the thickness of battens on the form, the ribs and the planking itself. Erect the backbone on slanting supports so that the lower edge is exactly parallel with the floor and 33 in. above it. Use five pairs of legs for this purpose, at stations Nos. 1, 2, 4, 7 and 8, and nail on the pairs of form molds at the stations designated, in the manner shown in Figs. 2, 6, 7 and 8. Note that the form molds join the backbone just at the bottom of the notches, and station No. 8 only is between two notches, Figs. 2 and 6. This form does not extend aft as far as the stern, the reason for which will be explained later. Pine battens, ⅞ x 1½ in., are now nailed

Actual construction begins with the keel, which is made up of two members, the keel proper and the keelson. Material for both is of selected oak



curve as in Fig. 12, with the full dimensions given in Figs. 11 and 12. Each of the pieces is 18 ft. long, and they must be screwed together in the bent position. To do this, nail blocks to the floor and fit the pieces as in Fig. 11. The screws are set in a double row, 6 in. apart, and should be spaced to come between the ribs. The slot for the centerboard must be cut before putting the keel unit on the form. Location and dimensions are given in Fig. 11.

Installation of the ribs comes first. The ribs are $\frac{5}{8}$ x $\frac{7}{8}$-in. oak, in 9-ft. lengths. They must be steamed for at least half an hour. Two suggestions for boiling or steaming are given in Fig. 10. The ribs are placed directly in the water, and when removed are bent over the form as soon as cool enough to handle. Lay one in a notch in the backbone to locate it, then bring down the ends and clamp and nail to the lowest batten. With the ribs in place, you install the keel unit with screws and washers through the centerboard slot to hold it in position while the screws through the keelson into the ribs are being driven. That portion of the keelson extending beyond the keel, Figs. 17 and 19, is now beveled so that, when a plank is laid over it and the filler block, it will lie flat.



Above you see the keel, ribs and transom in place and the stem being fitted. Below in Fig. 17 is a very important detail. The bevel of the keelson must coincide exactly with the slope of the filler block so that you get an even bearing for the plank

The stem is cut from a piece of oak 2¾ x 12 in. x 5 ft., as laid out in Fig. 4. Between the rabbet and bearding lines is the long groove or rabbet into which the planking fits. The best way to make this groove accurately is to notch at intervals with a chisel, as in Fig. 14, testing for depth with a fid as in Fig. 15. This is merely a strip 1 in. wide and long enough to reach back to station No. 1. The fid will also serve as a guide in beveling the portion between the rabbet and the face. Secure the keel to the stem with four $\frac{5}{16}$-in. bronze bolts and drill a $\frac{3}{8}$-in. hole in the joint where indicated for the stopwater, Fig. 4, a white-pine dowel, which will swell and close this joint tightly.

Philippine mahogany makes a durable transom, the latter being cut from a piece 14 x 30 x 1½ in. thick. This will give a wide bearing for planking as well as the keel. You find the transom pattern in Fig. 18. It should be sawed to the greatest bevel, thus leaving enough stock to work down later. Bear in mind that the pattern in Fig. 18 will not coincide with the projection of the transom in Fig. 3 as the latter is set at an angle of nearly 45 degrees.

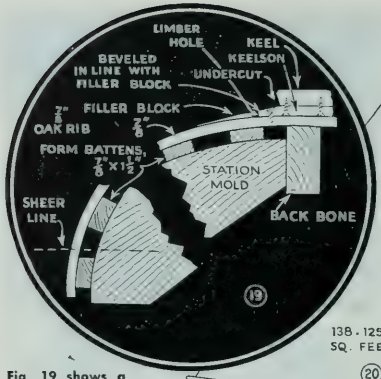


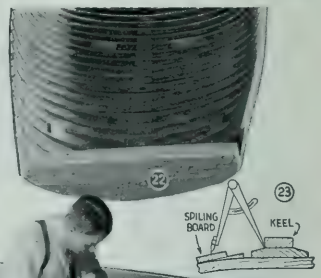
Fig. 19 shows a cross section of the hull area all ready for planking. It's well to know in advance the sail area, as shown in Fig. 20

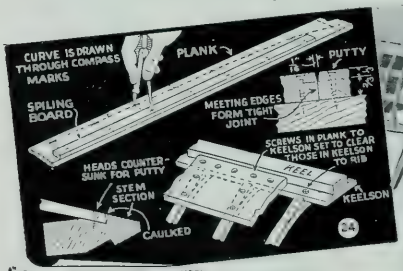
Fig. 21 shows how to bore the rudder-post hole, using the after skeg as a guide

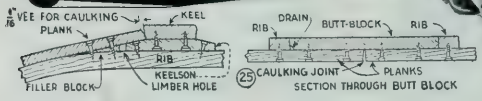
The transom is mortised for the keelson, but not the keel, as shown in Fig. 18. An oak knee is bolted to the keel and transom and is further secured by braces down to the floor, as in Figs. 16 and 18.

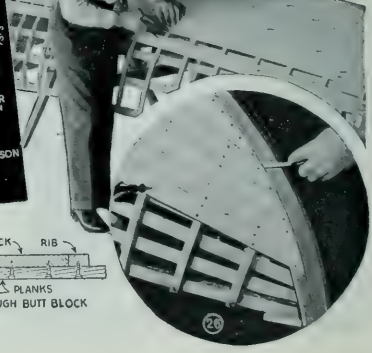
Fig. 18 gives the pattern for the skeg, which is secured to the keel with two galvanized carriage bolts and two screws as in Figs. 13 and 16. The after edge of skeg gives the angle of the rudder post, and serves as a guide in boring the 1 3/16-in. hole for the rudder-post tube, Fig. 21.

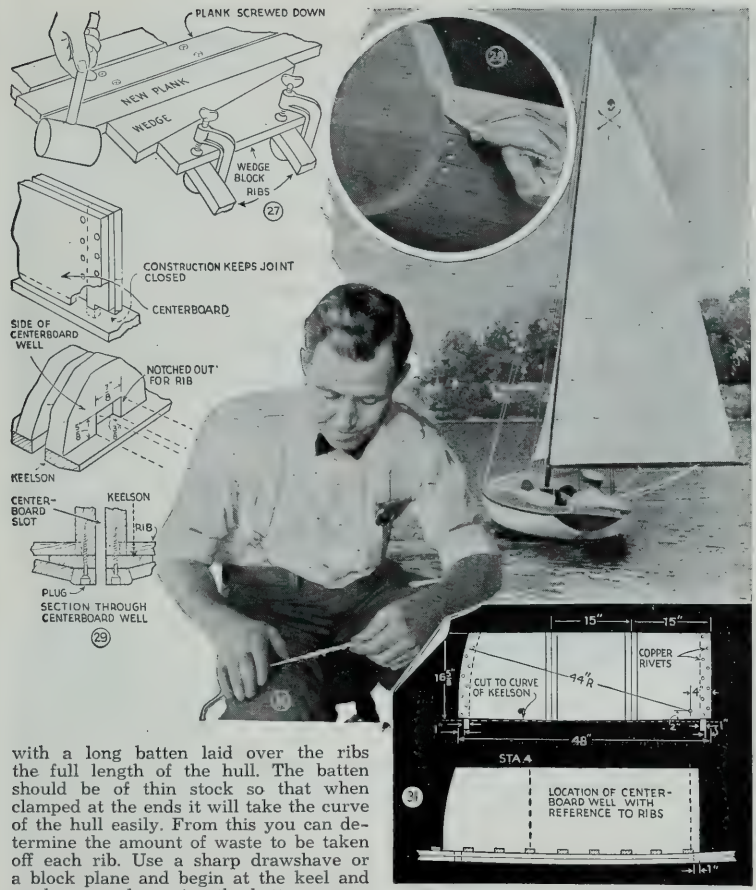
Now each of the ribs must be faired off, so that the first plank on each side of the keel will be flat. The best way to do this is









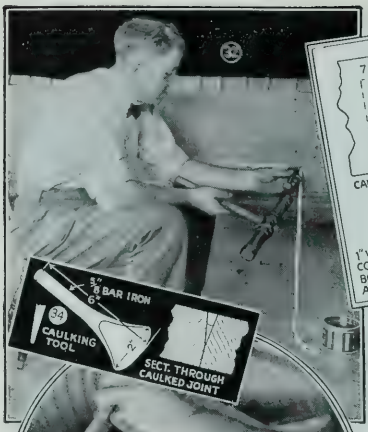


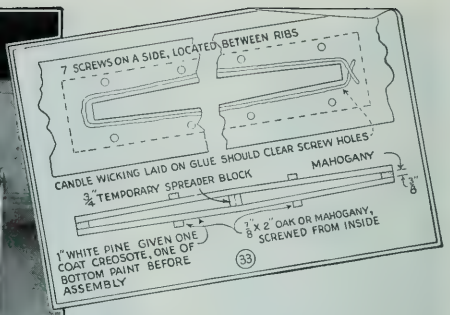
Novel construction of the centerboard well allows the wood to swell without opening the joint. All seams are waterproofed with caulking cotton

with a long batten laid over the ribs the full length of the hull. The batten should be of thin stock so that when clamped at the ends it will take the curve of the hull easily. From this you can determine the amount of waste to be taken off each rib. Use a sharp drawshave or a block plane and begin at the keel and work outward, moving the batten as you go along. The essential thing is to make sure that the batten bears equally on each rib. This means that at stations fore and aft you will have to bevel the ribs considerably and the degree of the bevel will vary somewhat from the keel to the sheer line. Each individual rib is faired off so that the batten bears its full width. Should any of the ribs be left with the batten touching only one corner, an imperfect joint between the rib and the plank will result. A condition of strain will exist which is likely to either split the plank or pull the screws through it. You should be particular with those ribs between the stem and station No. 3, for it is here that the greatest curve comes in the planking. The bevel on the transom should be faired back from the keel only the width of the first two or three planks as there is a point in connection with this bevel that will be covered on the following pages.

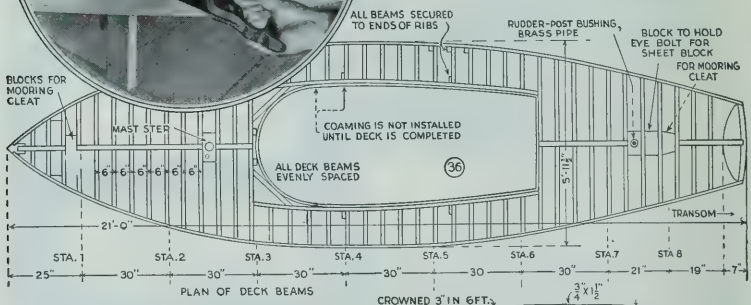
Laying the Planks

Now that the frame is complete, the planking is done while the frame is still on the form. First, provide a spiling board



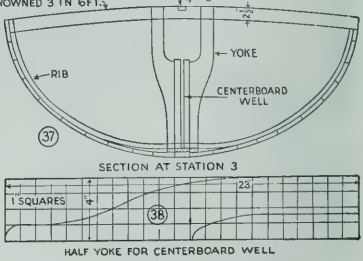


along the keel as in the sectional view, Fig. 25. Incidentally, the plank should be screwed down only temporarily until you are sure that it fits snugly against the keel. There are three screws into the keelson between the frames, so located that they will not strike those through the keelson into the ribs, Fig. 24. Planks are in three widths, 6 in., 7 in. and 8 in. The wider planks are installed near the keel and sheer line with the narrower planks between, where the greatest curve occurs. Each plank should fit snugly against its

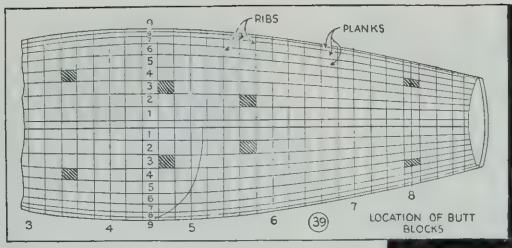


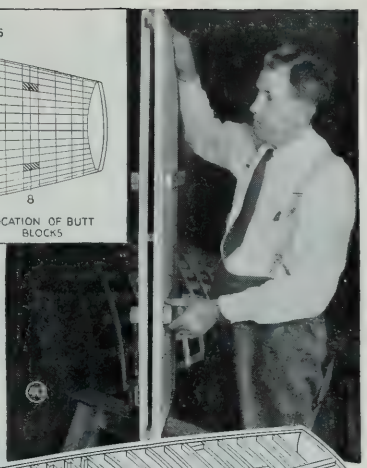
on which measurements are made to determine the curve on the edge of each plank, Figs. 23 and 24. This spiling board should be about ¼ in. thick and 3 in. wide, preferably of spruce, which will permit it to lie flat over the curves of the hull. Nail it temporarily to three or four ribs and mark off distances with a pair of dividers as in Fig. 23. The spiling board is laid on an uncut plank and the required curve plotted as in Fig. 24.

The first plank, next the keel, comes well forward on the stem, Fig. 26. The joint at the rabbet line should be about 1/16 in. wide to admit caulking. This should be carried the full length of the plank

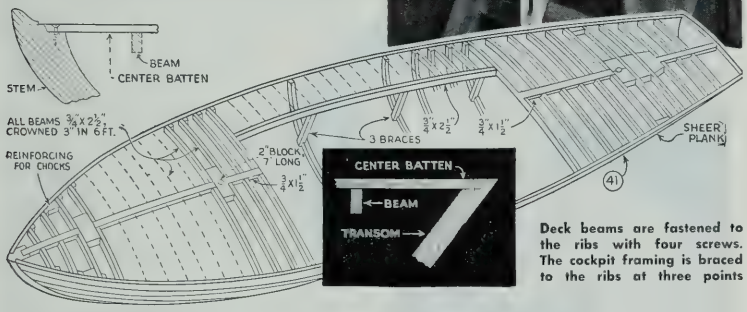


After planking, the hull is lifted off the form and placed on saw horses for installation of the deck





neighbor for two thirds of the width of the edge, the remaining third forming a V-groove for the caulking, Fig. 24. To bring the planks tightly together use a wedge arranged as in Fig. 27. Although the planking comes from the mill long enough to run from stem to transom, it will be necessary here and there to make



Deck beams are fastened to the ribs with four screws. The cockpit framing is braced to the ribs at three points

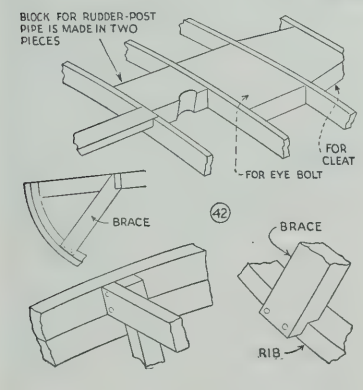
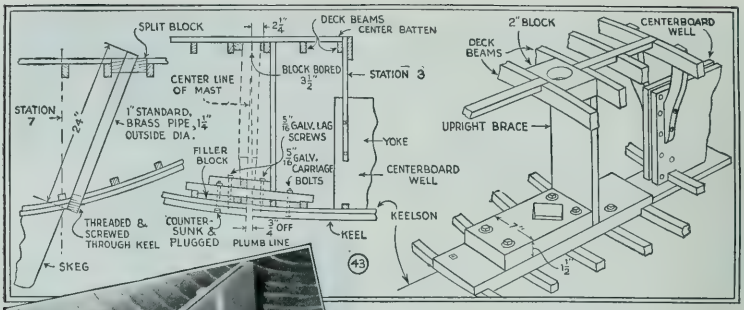


Fig. 42 shows how blocks are mounted for the inside fittings, including the housing for the rudder post

an end joint backed with a butt block, as in Fig. 25, the butt block being the same width as the plank. At the corners between rib and plank, a triangular opening should be left for a drain. There should also be a space between the plank ends for caulking. In the original hull, the butt blocks were located as indicated in Fig. 39. The sheer-line marks on the ribs, mentioned previously, will indicate the gunwale edge of the top plank. When all have been permanently installed, the joints should be planed smooth. Also round over the corners of the planks at the transom, except about 1½ in. where the stern molding is to be fitted, Fig. 28.

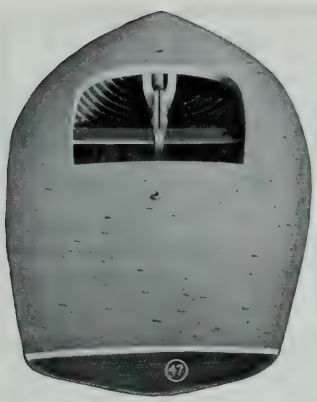
While still on the form, all seams are caulked. Make or buy a caulking tool similar to that in Fig. 34. Divide the caulking cotton into three strands and roll it into a fairly tight cord as in Fig. 30. This is worked into the seam and driven home with the caulking tool, Fig. 32. The tool is frequently dipped in oil. The blade should be smooth, as any burrs tend to pull the



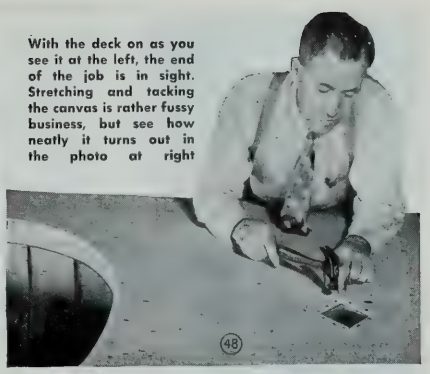
Two yokes and an upright brace at the forward end of the cockpit give rigid support to the mast step and the centerboard well. Position of step gives the mast a rake of ¾ in. aft. Before the deck beams go on apply two coats of marine paint to the interior of the hull as in Fig. 46. Paint should be worked into corners at ribs and keelson. The first coat of paint should be thinned to soak in well; the second coat is applied without thinning

cotton out each time the tool is withdrawn. It is assumed that before caulking or planing the hull, the two ribs have been installed just forward of the transom. These are bent oak ribs and are installed by screwing first to the keelson on the inside, then to the planks from the outside. With the hull complete, sanded and caulked, it can be removed from the form and turned over. This is accomplished by sawing the ribs at the sheer line, as in Fig. 35. Three or four men can easily turn it over as it weighs approximately 400 lbs. at this stage of construction. Set the hull level on saw horses and brace it as in Fig. 45.

Now to build the centerboard well, Fig. 31. This is 16⅝ in. high at the greatest width, the bottom edge being cut to conform to the curve of the keelson. The sides are of white pine with mahogany bulkheads or spacers at the ends. These are slightly beveled to take care of the greater width of the opening at the center, and a ¾-in. piece is inserted here to keep it spread apart until screwed down on the keelson, Figs. 33, 40 and 44. The spreader piece is needed because a centerboard well always has a tendency to bow in, owing to the swelling of the wood. An ingenious lock joint is also incorporated in this well, Fig. 29. This allows the wood to swell at right angles to the grain without opening the joint. Before assembly, the inside of the well is painted with one coat of creosote and one of bottom paint, and the mahogany cleats are screwed on. The location of the well will be determined by the slot already cut in the keel member. Notches are cut only ⅜ in. deep for the ribs, as in Fig. 29, the ribs being cut to length accordingly. When fitted in place, lift the well and drill holes for No. 14 screws in the keel member as in Fig. 33. Then with a punch, mark corresponding



With the deck on as you see it at the left, the end of the job is in sight. Stretching and tacking the canvas is rather fussy business, but see how neatly it turns out in the photo at right



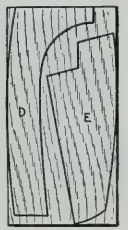
Save on material by cutting the six pieces needed for the deck from three plywood panels as shown in Fig. 49, below

locations in the edges of the well, and drill holes for the 3-in. screws, which are to hold it in place. The joint is first treated with marine glue and a strand of candle wicking laid along it as in Fig. 33. The wicking should be kept clear of the screw holes. The screws are countersunk $\frac{3}{8}$ in. and the holes closed with wood plugs. Fig. 22 shows the hull completed to this stage. Follow with two coats of marine paint.

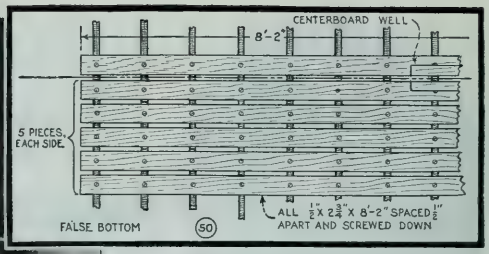
Deck and Cockpit

Now for the deck framing. To get the crown equal on all 40 beams it is best to make up a pattern. All beams are pine, except those at ends of the cockpit, which should be oak or mahogany. The ends of the beams are nailed to the tops of the ribs with galvanized nails, and pilot holes should first be drilled to prevent splitting the ribs. A center batten runs along forward and after decks and sets flush with the tops of the beams. This construction is shown in the cross section, Fig. 37, and also in Fig. 41, which shows how the center batten joins the stem and transom, and gives the location of diagonal struts or braces under the deck at the sides of the cockpit. A number of blocks are installed for various fittings, that for the upper end of the brass rudder-post tube being made in two pieces as in Figs. 36 and 42. The tube itself is 1-in. standard brass pipe, Fig. 43, the inside diameter being slightly over 1 in., which permits free movement of a 1-in. rudder post. The lower end is threaded to screw directly into the wood keel unit. It is not installed permanently until canvas is put on the deck. Locating the mast step is important, as it must give the proper rake to the mast. The center line should be $\frac{3}{4}$ in. farther forward at the keel than at the deck line, as in Fig. 43, which also shows the relative position of the mast step and the centerboard well. When you install the blocks supporting the foot of the mast, it is well to see that holes for the bolts and lag screws do not come in line. An upright and a yoke reinforce the deck at the forward end of the cockpit. A profile of the yoke is given in the squared detail, Fig. 38. These parts are cut from $\frac{3}{4}$-in. oak or mahogany.

Arrowhead's deck is of waterproof plywood covered with canvas, as in Fig. 47. Six pieces of $\frac{1}{4}$-in. plywood are required. These are cut in duplicate from three panels as in Fig. 49 and are to be fitted as in Fig. 52. However, there are two things to be done before you screw down the deck permanently. The false bottom, Fig. 50, should be installed before any work is done on the deck. This will avoid the necessity of walking about on the unprotected ribs and planking when you get inside the cockpit. Although the decking is of thin plywood, which bends easily to the curve of the beams, installing it right is a rather fussy job. The important thing is to make sure of a perfect fit along the centerline, at the



DECK IS CUT FROM THREE PLYWOOD PANELS, ¼" X 4'-0" X 8'-0"

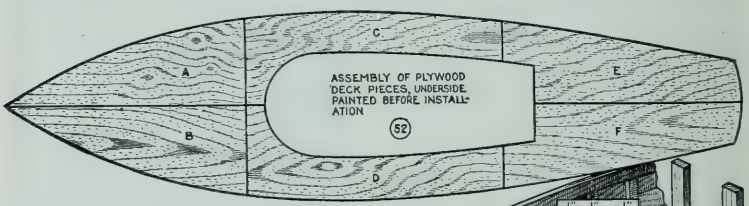


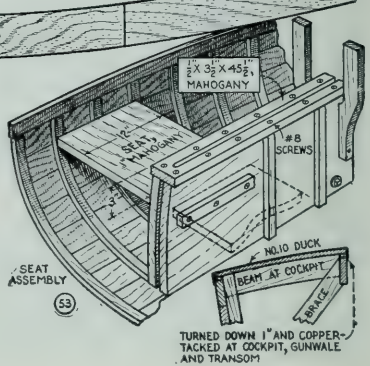
Be sure that the canvas is folded under at the edge so that each tack goes through two thicknesses of cloth. Space tacks evenly, not more than 1 in. apart

butt joints, and particularly at the gunwales. This means that you will have to fair off the top face of the gunwales so that the curve of the beam is continued unbroken to the outer edge. Unless you are particular in thus fitting all the individual pieces which comprise the deck, you are likely to finish with unsightly bulges or depressions which will mar otherwise smooth contours. When you are sure the fit is right, give the underside of the plywood one coat of inside hull paint and screw the pieces down to the sheer plank and beams with ¾-in. No. 6 bronze screws spaced as in Fig. 54. Then smooth up flush with plane and sandpaper around gunwales and cockpit.

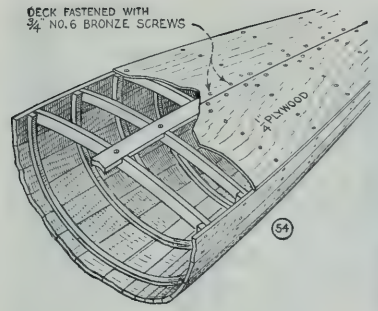
Now give the plywood deck a coat of lead and oil paint, mixed fairly heavy, and before this dries stretch the canvas deck covering, fastening all around at the gunwales and over the transom with copper tacks as in Fig. 51. Notice from the material list that this is No. 10 duck—not 10 oz. Now a line of tacks is run around the cockpit close to the edge on the top side to hold the canvas while you cut away for the opening, leaving a flap or overhang of about 1 in. for permanent tacking. These tacks are driven in only part way so that they are easily removed when the final tacking is finished. Proceed in the same way at the deck openings for the mast and the mainsail halyard, as in Fig. 48. The tacking finished, give the canvas two coats of oil paint, the first coat thinned so that it will penetrate the cloth. Follow the second coat with one of enamel.

Now you go inside to finish up the cockpit. The seats, Fig. 53, serve a three-fold purpose, as they act as braces for the cen-

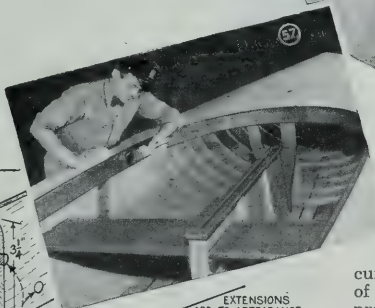




In installing the deck, make sure of a perfect fit along the centerline and at the butt joints, so that these do not show under the canvas covering



terboard well and also support cleats for the mainsail halyard and centerboard gear. The seats should be of 1-in. mahogany, the outer ends being supported on cleats screwed to the ribs. A strip of mahogany, slotted to proper width and with top edges neatly rounded, finishes the top of the centerboard well. Details of the

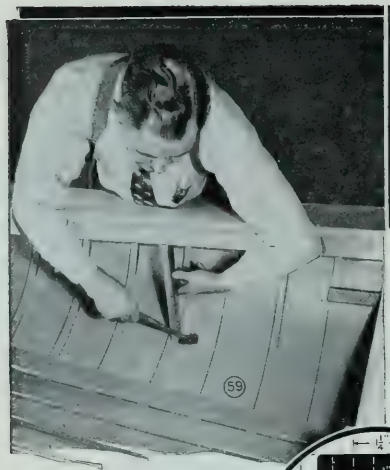


Screw heads are puttied over with a marine lead putty after the first coat of paint is applied. All mahogany parts are finished with three coats of spar varnish

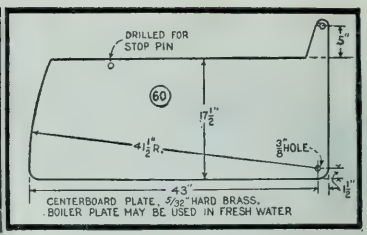
Details of the coaming, assembled from three parts, is shown above. Note angle joint between side pieces

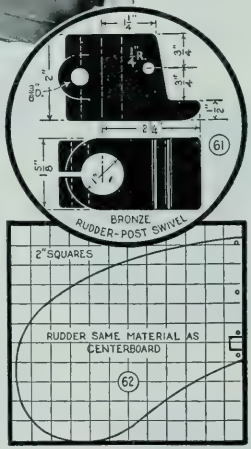
coaming are shown in Fig. 58. This is in three parts, the forward section being steamed and bent to fit the curve of the cockpit. The after ends of the side pieces are notched to provide extensions which add to appearance. Notice especially the angle joint between the side pieces and the curved end of the coaming, Fig. 58. This is not only cut at an angle, but the ends of the joining members are beveled so that one overlaps the other. The parts are fastened with staggered lines of bronze screws, the heads countersunk 3/16 in. and the holes plugged with mahogany plugs. A ¼-in. molding of mahogany finishes the job. Note that the coaming extends only ¼ in. above the deck level in the detail, Fig. 58. If desired, it may be higher. Finally, you have to install braces from the ribs to the edges of the cockpit as in Figs. 53 and 59.

The projecting canvas flap and the tacks around the gunwales



Braces along the sides of the cockpit carry the strain down to the ribs, thus giving ample strength to support persons sitting on the edge of the cockpit





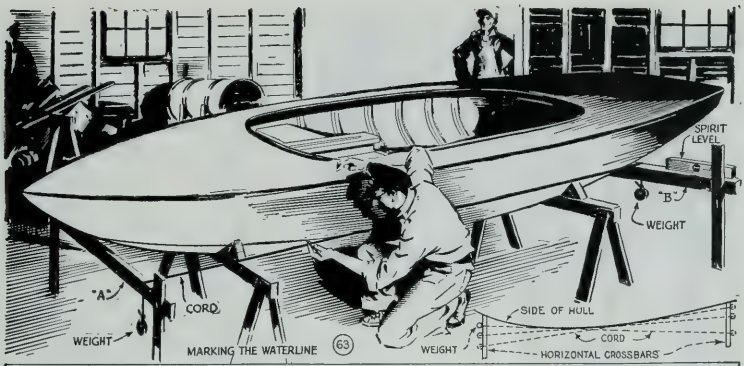
are then covered with a half-round mahogany molding, Fig. 58, and the stem is finished with a half-round molding of solid brass as in Fig. 55. All parts of mahogany including the transom are finished in the natural color with three coats of spar varnish as in Fig. 57. The first coat is thinned with turpentine so that it will penetrate. Succeeding coats are lightly sanded.

For use in salt water, the centerboard, Fig. 60, should be of hard brass, though for fresh water, boiler plate will be satisfactory. The rudder, Fig. 62, should be of corresponding material of the same thickness in either case. Now, before you install the rudder, turn out the rudder-post bushing and coat the threaded end with thick white lead, then tighten it back in place. The rudder-post head or swivel, Figs. 61 and 65, is a bronze casting shaped as in Fig. 61. The head is drilled and slotted so that it will clamp to the rudder post as in Fig. 65, which shows the complete rudder assembly. Notice that the post is slotted to take the rudder, which is held in the slot with brass rivets. A collar brazed to the post provides a shoulder against which vertical rudder-post play is taken up. A brass strap hinges the lower post end to the skeg. The tiller, Fig. 64, is hinged to the rudder-post head as in Fig. 65.

Now, with these parts in place you are ready for the operations which finish the hull—marking the water line and painting. One method of marking the water line is shown in Fig. 63, where the hull is leveled on saw horses and the line is located by means of a cord, weighted at both ends and supported on straightedges set up so that they touch the water line at bow and stern. The taut cord is simply moved along the straightedges and the points at which it touches the hull are marked. A line drawn through these points will give you the water line. Now the area below the water line is given one coat of anti-fouling bottom paint, and the balance, one coat of marine hull paint. When the first coat is dry, the screw heads are puttied over as in Fig. 56, using a marine lead putty. Follow with two additional coats of paint, the anti-fouling bottom paint being applied below the water line as before. In painting, the first coat should be reduced somewhat so that it will penetrate the wood and form a base for succeeding coats. Keep the paint film brushed out well as heavy applications are apt to scale or peel back to the wood. Be sure that the preceding coat of paint is thoroughly dry before you apply another. Sanding may be necessary between coats to assure a smooth surface.

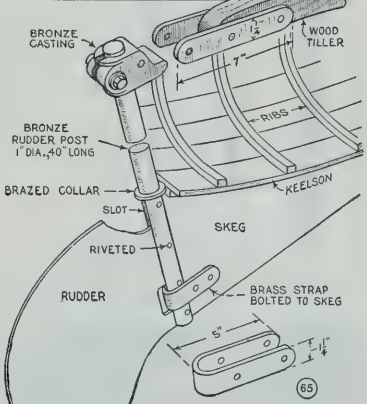
Mast and Rigging

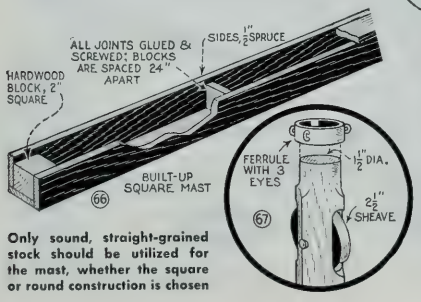
Now up with the mast and rigging! First of all, you have to decide whether you want the square, built-up mast or the solid,



When ready to mark the water line you're really "on the last long mile." You can do this as shown above and avoid the bother of turning the heavy hull over

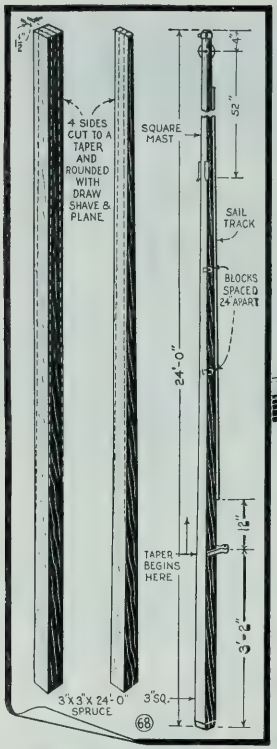
round type, Fig. 68. If local conditions require the use of a spreader or adjustable backstay rig, as in Figs. 80 and 81, the round mast is preferable, as it is trim and neat and the fittings are more easily put in place. On the other hand, if you use the rig shown in Fig. 76, which is practical under average conditions, the square mast is perhaps the better, due to its greater strength and rigidity. Details for constructing it are in Figs. 66 and 68. From Fig. 68, notice that the section above the gooseneck band, or spider, tapers from 3 in. square at a point 3 ft. 2 in. above the foot to 1½ in. square at the tip. The four ½-in. strips which compose the sides should be a full 24 ft. in length and the taper should be sawed or planed on the pieces before joining together. Great importance attaches to





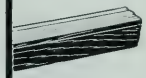
Only sound, straight-grained stock should be utilized for the mast, whether the square or round construction is chosen

the grain and quality of the wood selected. Nothing but the best will do for this job. Look out for knots or dark streaks that may mean a weakness in the grain. Another important thing is to plane the tapered edges exactly at right angles to the face in order to get a good glue joint all along the length. Then you can set two of the strips at right angles with waterproof casein glue in the joint and draw together with flat-head brass screws spaced about 6 in. apart. Of course, you can use copper nails but screws are better. At the foot a

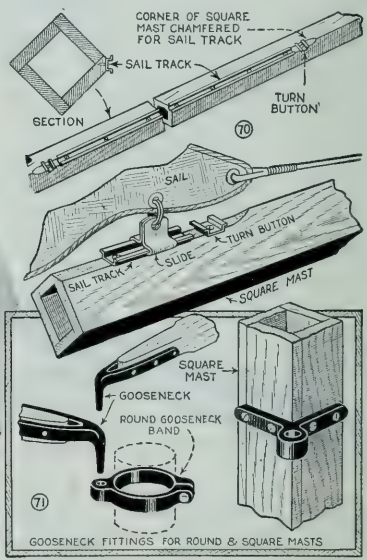


2-in. hardwood block is fitted, as in Fig. 66. Then ½-in. spruce or pine blocks are spaced 24 in. apart along the length after which they are glued and screwed in place. Addition of the remaining strips completes the mast ready for the fittings. The tip is rounded and fitted with a brass or galvanized ferrule with three eyes for stays. Just below the ferrule, the mast tip is mortised diagonally for a sheave carrying the mainsail halyard as in Figs. 67 and 73.

The solid round mast is also tapered, the same dimensions holding for both the round and square types. To begin with you must have a perfect piece of stock, sound, straight-grained and free from knots. Producing the round mast is a matter of cutting away the waste to the proper taper and then rounding to the circular section with a plane or drawshave. The thing to look out for in planing down to size is to keep the circular section uniform throughout the length. This is important, as any material unevenness will weaken the mast. When you get it planed down to size, smooth with sandpaper and apply two or more coats of spar varnish. The round mast carries the same fittings and the foot is squared to fit the step. The boom, Fig. 76, is made of the same material and in the same way as the round mast, but is not tapered and is only 2 in. in diameter.



You'll save time and trouble by purchasing all deck and rigging hardware ready-made. The sail track, shown in Figs. 69, 70 and 76, has a turn button at each end to prevent the slides running off and fouling the sail. To make the turn buttons you simply cut short sections from the ends of the sail track and attach them



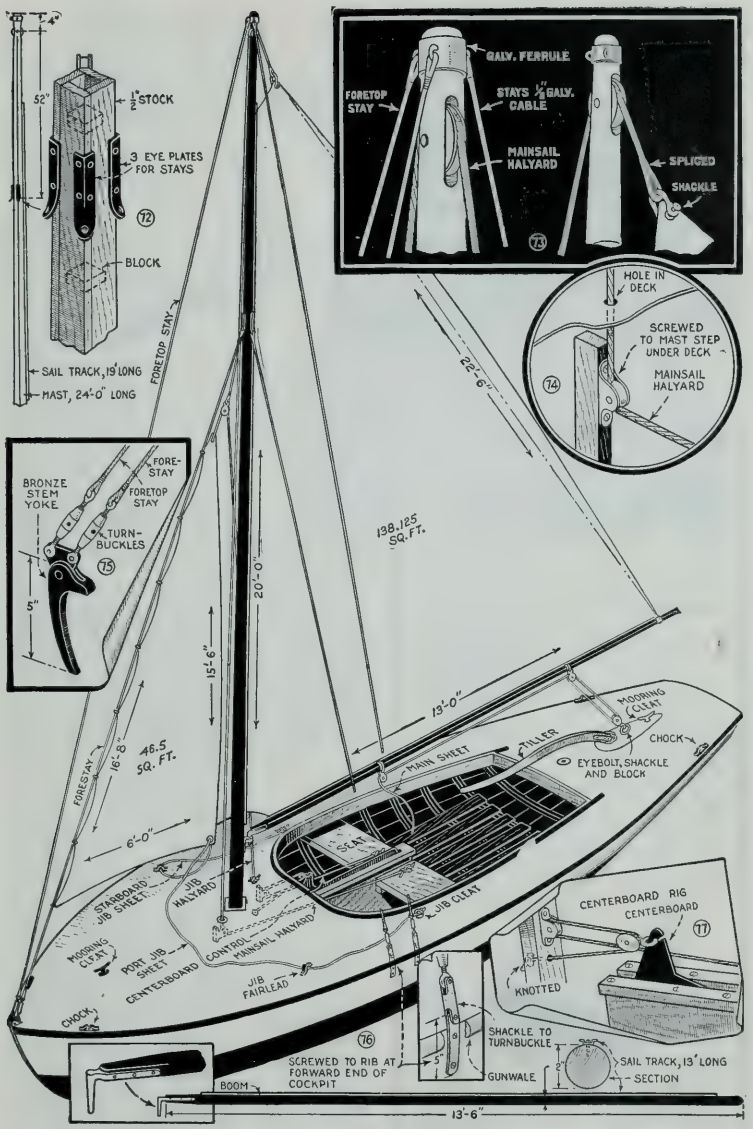
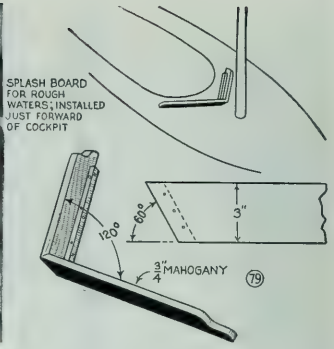
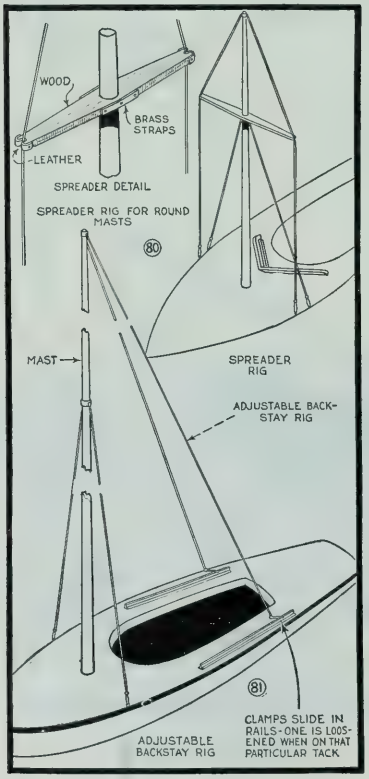


Fig. 72 shows how sail track and stays are mounted to the mast. Figs. 74 and 75 illustrate other rigging details. Figs 77 and 78 (on the following page) show the operation of sail-raising and lowering gear



Use a spreader or adjustable backstay rig. Splashboards will keep the flying spray out of the cockpit



to the mast and boom with separate screws as in Fig. 70. Fig. 71 shows the gooseneck fittings for both the round and square mast. The balance of the rigging details you'll find in Figs. 72, 74 and 75. The centerboard raising and lowering gear is shown in Figs. 77 and 78.

In some waters, splashboards like those shown in Fig. 79 will help to keep off flying spray. These are cut to the curve of the deck and screwed down to the deck beams between the mast and the forward end of the cockpit. Those who wish to use the spreader rig, Fig. 80, will be familiar with its construction. Adjustable backstay slides and clamps, Fig. 81, may be purchased ready-made, the complete unit being fastened to the deck with heavy screws. It's better to have the jib and mainsail made up complete by a competent sailmaker. All he needs are the specifications in the rigging plan, Fig. 76.

An Optional Finish

You have already finished the hull of your boat, but many builders, when the finish is white above the water line, apply a final coat of white lead and turpentine. This mixture is very chalky and when the boat is in the water it washes away slowly, making the boat retain a clean and freshly painted appearance for a long time.

If you want a smooth finish on the canvas deck, sand the deck with medium sandpaper. Then apply successive coats of enamel in the color desired. After each coat is thoroughly dry, give the deck another sanding. Don't make the mistake of applying the enamel too heavily. Two thin coats, carefully brushed out, will be far more durable than one heavy application. Proceeding in this way, you can build up a smooth surface on the deck. The enamel-surfaced deck is purely optional, however, since the canvas finish is pleasing and preferred by many boatmen.

Material List for Sloop "Arrowhead"

FORM AND HULL FRAME

LUMBER FOR FORM

Backbone—2 pieces 2 x 8 in. x 16 ft. 1 in. pine

Station molds—5 pieces 1 x 14 in. x 12 ft. pine

Battens—16 pieces ⅞ x 1½ in. x 19 ft. spruce

Miscellaneous lumber for cleats, legs, etc.

LUMBER FOR HULL FRAME

Stem—1 piece 3 x 12 in. x 5 ft. oak. (Skeg and transom knee cut from waste)

Transom—1 piece 1½ x 14 in. x 30 in. mahogany

Keel—1 piece ¾ x 2¾ in. x 18 ft. oak

Keelson—1 piece 1½ x 4½ in. x 18 ft. oak

Ribs—36 pieces ⅝ x ⅞ in. x 9 ft. oak

FASTENINGS

6 doz. No. 8 bronze screws, 1 in. long, keelson to keel

6 doz. No. 7 bronze screws, ¾ in. long, keelson to ribs

2 only No. 9 bronze screws, 2½ in. long, keel to transom

2 only No. 9 bronze screws, 2 in. long, knee to transom and keel

2 only No. 9 bronze screws, 2 in. long, skeg to keel

2 only carriage bolts (galv.) ¼ x 4 in., transom knee

1 only carriage bolt (galv.) ¼ x 5 in., skeg to keel

5 only carriage bolts (bronze) ¼ x 4 in., stem to keel unit

PLANKING AND BEAMS

200 board ft., cedar or cypress, 9/16-in. stock in 6, 7 and 8-in. widths for planking

2 pieces white pine, 1 x 17 x 48 in., for centerboard well

4 pieces oak or mahogany, ⅞ x 2 x 17 in., for centerboard well

2 pieces oak or mahogany, ½ x 2 x 18 in., for centerboard well

1 piece mahogany, ⅞ x 8 x 24 in., for yoke

2 pine boards, ¾ x 12 in., x 16 ft., for deck beams

16 No. 14 bronze screws, 3 in. long, for fastening centerboard well to keel

1 1-in. brass pipe, 24 in. long, for rudder post

14 doz. 1¼-in. No. 8 bronze screws to fasten planking

150 ft. cotton caulking

Marine lead paint, inside two coats

DECK AND FITTINGS

3 waterproof-plywood panels ¼ in. x 4 x 8 ft.—for deck

2 pieces mahogany 1 x 12 x 34 in.—seats

1 piece mahogany ½ x 3½ x 46 in.—cap for centerboard well

10 pieces pine ½ x 2¾ in. x 8 ft. 2 in.—false bottom

24 ft. mahogany ½ x 3¼ in.—coaming

24 ft. ½-in. mahogany quarter-round molding

1 piece ½ x 2 x 30 in. mahogany—transom molding

23 ft. 1¼-in. half-round mahogany molding—gunwales

1 bronze rudder post 1 in. dia., 40 in. long

7 yards No. 10 duck, 72 in. wide—deck covering

3 gross ¾-in. No. 6 bronze screws—for deck

Anti-fouling bottom paint, marine paint, spar varnish, and lead putty

MAST AND RIGGING

4 pieces spruce, ½ x 3 in. x 24 ft., for square mast

Or, 1 piece solid spruce, 3 x 3 in. x 24 ft., for round mast

1 piece spruce, 2 x 2 in. x 13 ft. 6 in., for boom

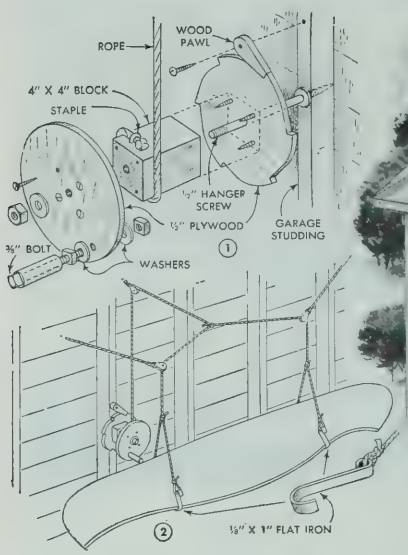
Marine hardware—sail track, eyeplates, ferrule, mooring cleats and chocks, pulleys, blocks and fairleads, stem yoke and gooseneck fittings as required for round or square mast

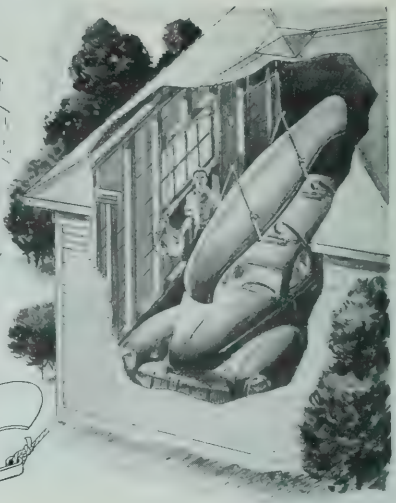
⅛-in. plowsteel cable for stays

Turnbuckles

Jib and mainsail ready-made

Reel Aids in Handling and Storing Small Canoe





Canoes, small boats and kayaks can be lowered to or removed from the top of a car with little effort if the reel and pulley arrangement shown here is used. When the craft is raised above the car it is stored out of the way until ready for the water again. Two of the pulleys are attached to the roof by short lengths of rope, and the third pulley, through which passes the rope attached to the hooks, is fastened to the side of the building. Size of the pulleys is determined by the size of the rope, and this in turn depends upon the weight of the boat. The reel is made as indicated in Fig. 1 and is screwed to the studding at waist height. The hooks, Fig. 2, from which the boat is slung are bent to fit over the sides of the craft.

Lantern Held Safely on Boat Deck By Rubber Clips Fastened at Base

To hold a lantern in a vertical position on a boat deck, one sportsman uses rubber clips tacked to the deck as in the drawing at left so that they overlap the flange around the base of the lantern. When not needed, the clips can be removed without marring the deck to any great extent.

Emergency Repair for Canoes

When spruce gum is available, a leaking canoe can be repaired even though you do not have a repair kit with you. After the leak has been located, clean the area and allow it to dry thoroughly. Then fasten a piece of spruce gum the size of a hickory nut on the end of stick. Heat the gum with a match and allow the drippings to fall on the leak. Spread the gum around the area with a heated knife.

PART 7

"Just for Fun" CRAFT

BICYCLE BOAT

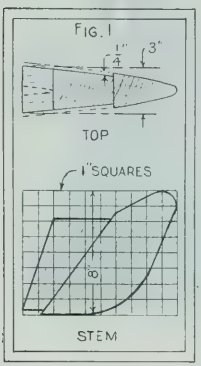
MOTOR PADDLE BOARD

KICK-KATAMARAN

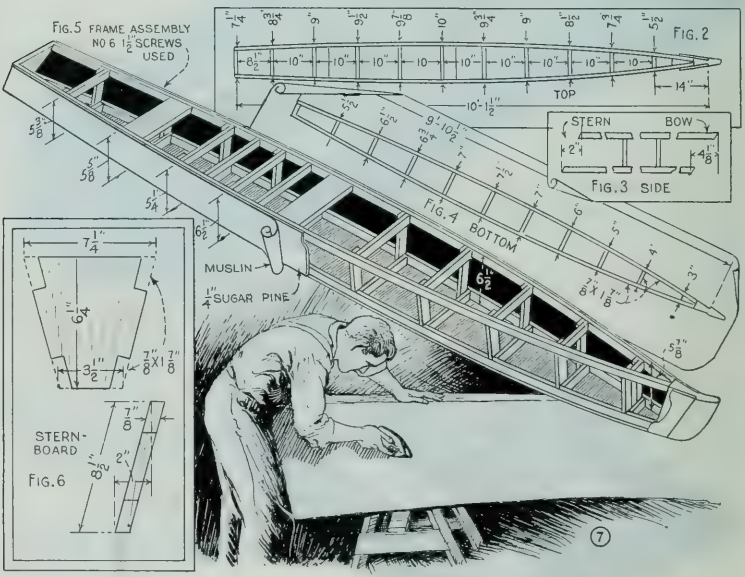
TREAD THE WAVES

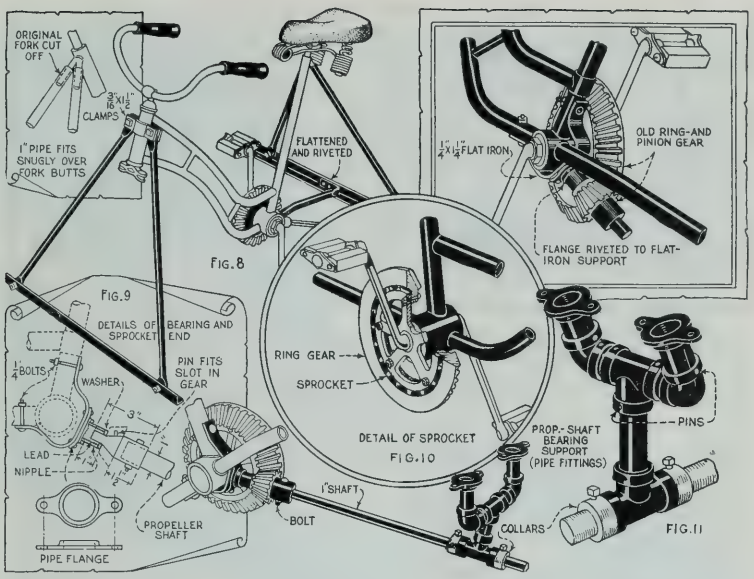
On This Bicycle Boat!

BUOYANCY and speed are two features of this bicycle boat. It consists of two pontoons and an old bicycle frame, held centrally above and between the pontoons. Propulsion is obtained by the use of a ring-and-pinion gear, bolted to the pedal sprocket, and a small three-blade propeller connected to the gears by a suitable shafting. The frames of the pontoons, both of which are exactly alike, are made of 1 x 2-in. white pine, which, when dressed, is exactly 7/8 x 1 7/8 in. Dimensions for the top and bottom crosspieces and



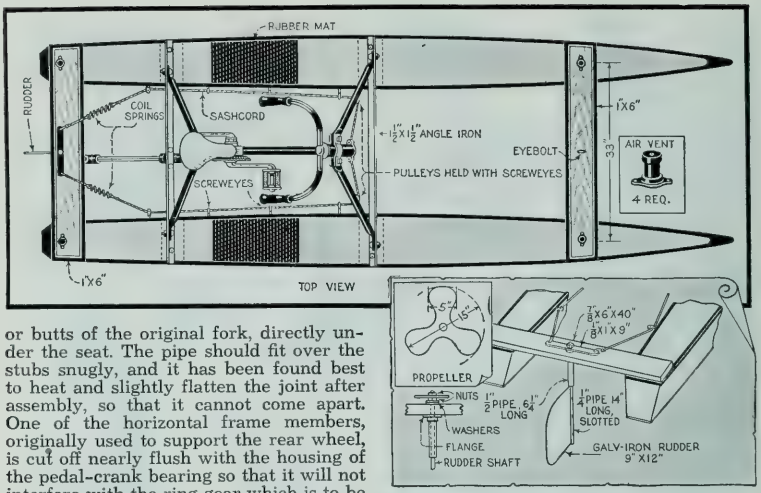
Pontoons for your bicycle boat can be made as shown or adapted from war-surplus airplane belly tanks





their spacing are clearly indicated in Figs. 2 and 4. Each frame consists of four pieces glued (marine glue) and screwed together, and notched to receive the longitudinal members—sheer and chine battens. Both stem and stern are set at an angle, which should be taken into consideration when building the frame (see Fig. 3). Details of the stem or nose block, which is cut from a piece of 2 x 8-in. spruce, are given in Fig. 1, part of the side being recessed ¼ in. to take the side planking. Exact dimensions and method of cutting the stern from ⅞-in. ash are given in Fig. 6. Note the additional reinforcing pieces provided across the top for the braces that support the bicycle frame, besides those that reinforce the deck directly under the rubber mats. When the frame has been finished, the side and bottom planking, which is cut from 12-ft. lengths of ¼ x 12-in. sugar pine, is screwed on after the contacting portions of the frame have been covered with marine glue. Then, with the top off, the inside of the pontoons is given an application of paint, and the top, also of ¼-in. sugar pine, is glued and screwed on, using ¾-in. flat-head brass screws. The heads of the screws should be countersunk, and the resulting holes filled with hard water putty. After sanding each pontoon smooth, it is given a liberal application of airplane cement, and heavy muslin is stretched over the surface. A hot iron is used to press the cloth securely to the wood as shown in Fig. 7. The seam should be made along the upper edge, where ½-in. half-round molding is applied, this being screwed on. A spruce keel of ⅞ x 1¼-in. stock is screwed to the center of the bottom of each pontoon. It is neatly joined to the stem, after which a strip of brass is run over the stem and a few inches along the forward part of the keel. Each pontoon is provided with two air vents made up of pipe fittings, to prevent the pontoon from bursting when the air inside expands in the heat of the sun. Be sure to apply glue to the fittings before screwing them in place over small holes drilled through the deck, to make them watertight. The pontoons are finished with a priming coat of shellac, four coats of good-quality exterior paint and finally a coat of spar varnish. Any desired color scheme may be followed.

Next comes the adaptation of the bicycle. A girl's bicycle is best, since the lack of a crossbar affords more convenient mounting. Cut off the front and rear forks as shown in Fig. 8. The bracing consists of lengths of pipe, flattened at the ends and bolted to angle-iron crosspieces. At the front end, flat-iron clamps are used to hold the braces to the steering post, while the rear pipes are slipped over short stubs



or butts of the original fork, directly under the seat. The pipe should fit over the stubs snugly, and it has been found best to heat and slightly flatten the joint after assembly, so that it cannot come apart. One of the horizontal frame members, originally used to support the rear wheel, is cut off nearly flush with the housing of the pedal-crank bearing so that it will not interfere with the ring gear which is to be added later. The corresponding frame member is cut off about halfway from the end, after which the cut portion is flattened and riveted to the rear angle-iron crosspiece. Fig. 10 shows how an automobile ring gear is bolted to the original pedal sprocket. It may be necessary to cut off the teeth of the sprocket to fit inside the recess of the gear. If desired, however, a brass disk may be substituted for the sprocket, in which case the disk should be the same thickness as the sprocket. A heavy piece of ¼ x 1¼-in. flat iron, bolted to the frame as shown in Fig. 9, holds a bearing that supports the end of the 1-in. propeller shaft. This bearing is made from a pipe flange and short nipple filled with melted lead and drilled to receive the machined fitting on the end of the shaft. If you have no metal lathe, this fitting can be turned out quickly at any machine shop. The tapered portion should make a snug fit in the pinion gear, and a small pin, driven into the tapered portion, serves as a key for the gear. A bolt holds the fitting on the shaft, while the latter runs through a bearing provided directly under the rear angle-iron crosspiece. This bearing and its hanger are made up of pipe fittings as shown in Fig. 11.

The angle-iron crosspieces are fastened to the pontoons with lag screws in the approximate positions indicated in the detail above, and additional crosspieces of 1-in. stock are provided at the front and rear. The pontoons should be placed perfectly parallel, 33 in. from center to center. Steering is accomplished by means of a small sheet-metal rudder, connected with sashcord to the front-fork stub of the bicycle. If a commercial propeller is not available, one can be made from fairly heavy sheet metal. It should have a 15-in. diameter, with a hole drilled centrally to fit the shaft, end of which is threaded so that the propeller can be held securely between two nuts. Corrugated rubber mats are tacked to the deck of the pontoons on each side of the bicycle, and the craft is then ready to go.

Boat-Drawing Aid

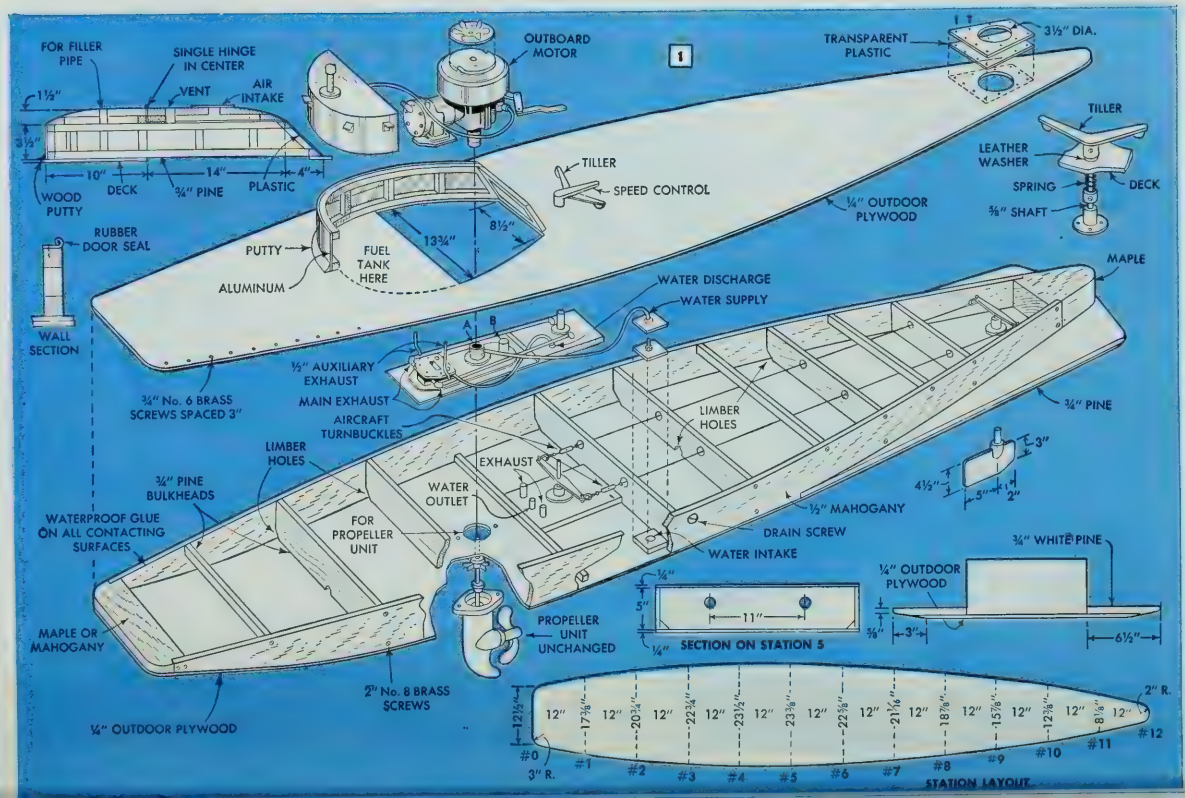
When fairing lines on a boat drawing, an inexpensive substitute for a naval-architect's spline and ducks can be improvised from a strip of plastic which is held in place on the drawing with tabs of masking tape. The plastic strip should be approximately 1/16 x 3/8 x 30 in. and the tabs are spaced 2 in. apart as shown in the photo. A pin pressed into the drawing board at each end of the strip helps hold the shape of the curve.

Skim the Waves
in this motor-driven paddle board

HERE'S something new in water-sports equipment — a motor-driven paddle board. It combines the common characteristics and seaworthiness of the surfboard and paddle board, but, more than that, it's power driven by a conventional outboard motor. That's the new angle. Smooth, sweeping "hull" lines, crowned deck and low motor hatch make this the sleekest, trimmest little craft you ever looked at. Light enough to be easily launched by one person, it rides rough water like a cork.

The hull, or board, itself is constructed just like the nonpower jobs, except that it is 5½ in. deep instead of the usual 3 in. or so on the conventional surfboard and paddle board. Deck and outboard plan views shown in Fig. 3 give the general over-all dimensions. Note that the motor hatch is placed well forward, giving ample room for a tall man to lie full length aft of it. Controls consist of tiller and speed lever, and a clear plastic transom permits a view inside the "engine room" from the rear. This, together with a midget headlight, could be lighted from a small storage battery for night cruising. General arrangement of the hull is shown in Fig. 1. Note that three of the bulkheads are only about half the width of the others and serve as deck beams. In the engine compartment is another half-bulkhead on the bottom, and the only one that is not spaced 12 in. on centers. The location of this is determined by the particular outboard motor you select.

In laying out the board, follow the dimensions given in the station layout, Fig. 1, which shows the stations all spaced 12 in. apart. To achieve a true curve, use a ⅞-in.-square spruce or pine batten, and, by bringing pressure at the ends, let it take a natural bend. Drive nails into the plywood

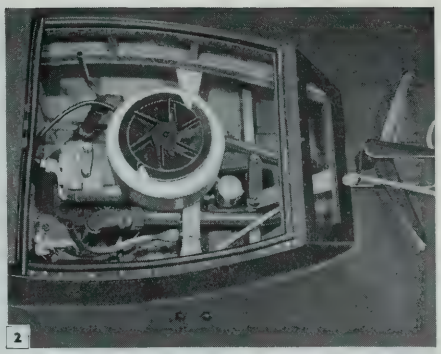

1
FOR FILLER PIPE
SINGLE HINGE IN CENTER
VENT
AIR INTAKE
1½"
3½"
10"
DECK
14"
¾" PINE
4"
PLASTIC
WOOD PUTTY
OUTBOARD MOTOR
TRANSPARENT PLASTIC
3½" DIA.
TILLER
SPEED CONTROL
LEATHER WASHER
SPRING
DECK
⅝" SHAFT
¼" OUTDOOR PLYWOOD
RUBBER DOOR SEAL
PUTTY
FUEL TANK HERE
ALUMINUM
13¾"
8½"
WALL SECTION
MAPLE
WATER DISCHARGE
WATER SUPPLY
A
B
½" AUXILIARY EXHAUST
MAIN EXHAUST
AIRCRAFT TURNBUCKLES
¾" No. 6 BRASS SCREWS SPACED 3"
LIMBER HOLES
¾" PINE
3"
4½"
5"
2"
LIMBER HOLES
¾" PINE BULKHEADS
EXHAUST
WATER OUTLET
½" MAHOGANY
WATERPROOF GLUE ON ALL CONTACTING SURFACES
FOR PROPELLER UNIT
DRAIN SCREW
WATER INTAKE
¾" WHITE PINE
¼" OUTDOOR PLYWOOD
¼"
5"
11"
¼"
SECTION ON STATION 5
⅜"
3"
6½"
MAPLE OR MAHOGANY
PROPELLER UNIT UNCHANGED
2" No. 8 BRASS SCREWS
¼" OUTDOOR PLYWOOD
12"
12⅛"
12"
17⅜"
12"
20¾"
12"
22¾"
12"
23½"
12"
23⅜"
12"
22⅝"
12"
21½"
12"
18⅜"
12"
15⅞"
12"
12⅜"
12"
8⅛"
12"
2" R.
#0
3" R.
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12
STATION LAYOUT

bottom ⅛ in. outside the station dimensions so that nails will not mar the panel, and at the same time leave material for trimming. The mark should be on the inside of the batten. The deck only is completely streamlined, the bottom having extensions aft which act as planes.

Details of construction are shown in Fig. 1. Side members of mahogany are notched into both nose and stern blocks after bulkheads have been installed. The latter are of soft pine, ¾ in. thick, with lower corners cut away for limber holes to permit any bilge water seeping in to flow from one compartment to another. Drain holes plugged with roundhead brass screws are located just forward of bulkhead No. 3 and aft of No. 5. When necessary these screws are removed and the hull tipped to drain.

In assembling, apply casein glue to all edges of the bulkheads and on edges of the side members. Where these parts contact nose and stern blocks, use marine glue. Brass or galvanized flat-head screws, 2-in., No. 8 size, are used to fasten parts to bulkheads and to nose and stern blocks. The bottom, which is installed before the deck, is fastened with ¾-in. No. 6 screws spaced 3 in. apart.

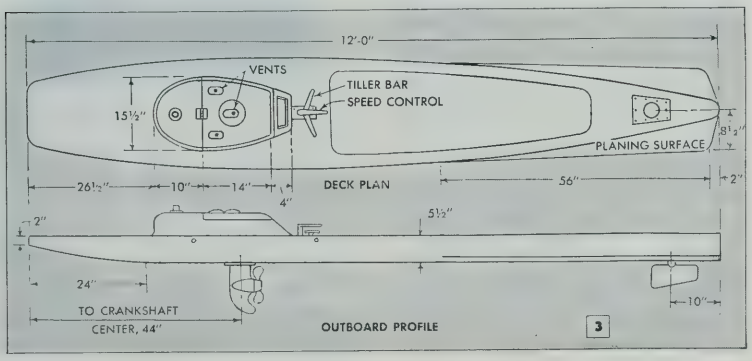
Extensions of the bottom serve as planing surfaces and are reinforced with ¾-in. soft-pine stock glued to extensions of the ¼-in. plywood bottom piece. Holes are cut in the full-size bulkheads for the steering cables, as indicated, and should be the same distance apart in each, in this case 11 in., or the width of the cable arms. An opening in the bottom for the propeller unit and various pipe fittings is cut later on. Steering is opposite that of a bicycle. Pulling the right end of the tiller back causes the board to turn left and vice versa. If one prefers the bicycle arrangement, cross the cables, cutting holes in the bulkheads accordingly.



2

Down view into engine hatch showing all fittings and flywheel fan in place. Note safety cord which attaches to the rider's wrist

The deck is cut from ¼-in. waterproof plywood, the same material as is used for the bottom. There are two openings in the deck piece, one for the engine hatch and a circular hole at the stern for steering gear inspection, to be covered with clear plastic and a brass plate secured with roundhead brass screws. Aluminum bent around a scrollsawed framework forms the wall of the superstructure, with the plastic panel in the after end covered with a brass frame and waterproofed with aquarium cement. At the juncture of wall and deck a fillet is made of wood putty, Fig. 1. The forward top is stationary, with a hole for the gas-tank filler cap. The rear end is hinged, and both are neatly rounded. Three



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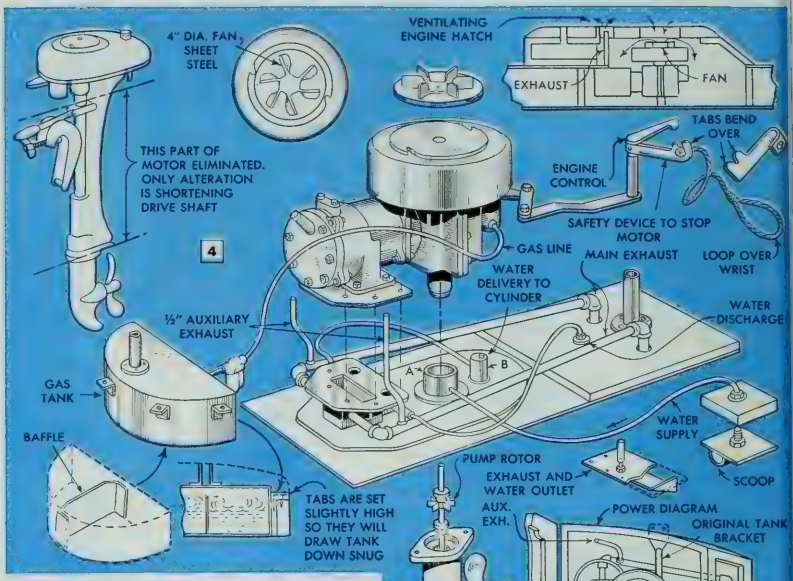
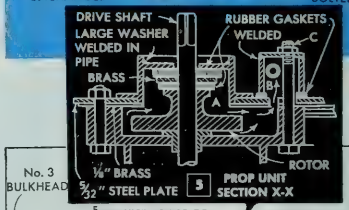
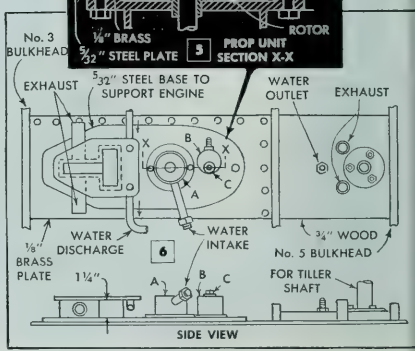


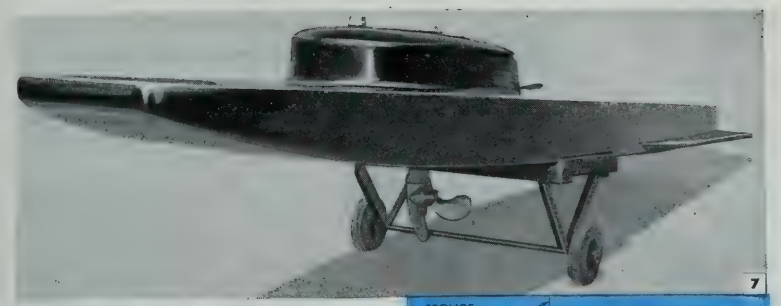
vents are provided in the hinged section and covered with standard scoop strainers obtainable from a marine hardware dealer. Top edge of the open section is fitted with a rubber door seal, making the compartment watertight when closed. A latch is installed at the rear end.

Any small outboard motor is suitable for this craft. In the original a 3½-hp., single-cylinder, 2-cycle motor was used. No alterations were required except removing the parts shown in Fig. 4 and cutting off the drive shaft and filing the end square. A 4-in.-dia. fan bent from sheet steel is bolted to the top of the starting disk on the flywheel to ventilate the engine hatch. The engine control unit is fitted with a safety device consisting of a notched arm to which the starting cord is attached. A loop of the cord is put over the wrist. If the rider slips overboard the tug on the cord automatically shuts off the power.

The semicircular gas tank is made of sheet brass, with four tabs, Fig. 4, located so that they will draw the tank down snugly on the deck. A baffle is installed with corners cut away. The filler cap is simply a pipe with a flange brazed to the top. Ventilation by the fan is aided by exhaust from two auxiliary pipes discharging through two forward openings as in the upper right-hand detail, Fig. 4.

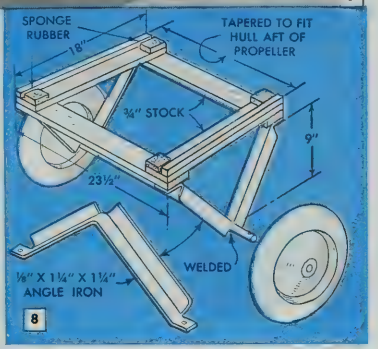






7

Because of the propeller-shaft extension a launching dolly is necessary. This is designed to fit the hull snugly and makes the craft easily portable on dry land



8

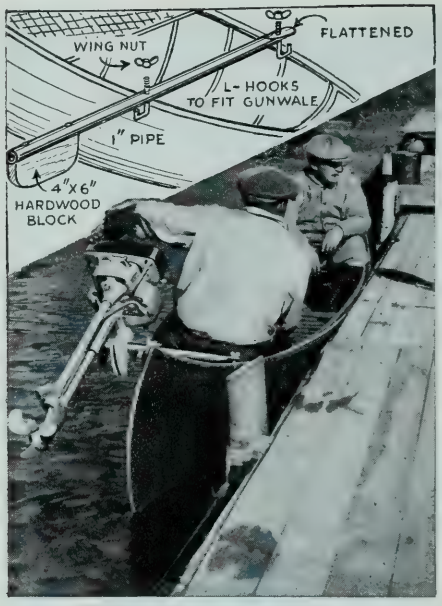
In order to keep the engine as low as possible, a special base is made upon which to mount it, incorporating connections for water and exhaust, Fig. 7. This is a welding job on 5/32-in. steel plate and makes a very compact unit to which the engine is bolted. It rests upon a brass plate bolted to the bottom. A similar plate has the exhaust and water outlets brazed in. Assembly of connections on these two units is shown in Fig. 4. Exhaust pipes are installed as indicated, with an auxiliary exhaust of ½-in. copper tubing in each adding to the power of the motor by relieving back pressure of the underwater exhaust. The underwater outlets are covered by a reverse scoop into which the cooling water also discharges. The scoop is bolted through the plywood bottom, the brass plate upon which the outlets are brazed, and also through a board on top. This assembly is just forward of bulkhead No. 5.

Water is drawn into part A, Fig. 4, from the intake scoop through copper tubing, delivered from B, Fig. 5, into the engine base, then up around the cylinder and out again to the outlet between the exhaust pipes. All brass-tube fittings are silver-soldered. The housing of the crankshaft bearing fits down in part A and the pump rotor is directly under it in the flange of the propeller unit, Fig. 5. The plywood bottom is cut away to receive this streamlined flange, and is bolted through the brass plate and steel engine base. The rear bolt C, Fig. 5, also passes through part B. The latter consists of a section of pipe with the top welded on and a nut also welded to it. This is offset to allow for the water opening at the bottom, Figs. 5 and 6. Part B is drawn down on a synthetic-rubber gasket. This material is impervious to oil. Washers of this same material are used around the drive shaft above and below a brass washer, part A, forming a watertight joint. Part A is a section of pipe with a washer welded just below the top, forming a cup for the accommodation of the crankshaft bearing hub. Another sectional view of part B is shown in Fig. 5, indicating where the welds are made.

A down view of the power plant is shown in Figs. 2 and 4, indicating how the engine is braced crosswise by extensions on the original tank bracket bolted to the deck.

The tiller consists of a handle bar of heavy sheet metal bent as in Fig. 1 and welded to a collar which in turn is bolted to a 5/8-in. shaft. Below deck is another collar with a spring above it. The latter holds the tiller down against a rubber washer, making a watertight joint. The tube for the engine control shaft is high enough above the deck to keep water out.

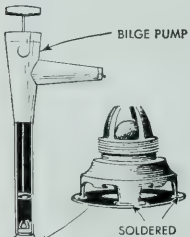
A simple but sturdy dolly for launching is built as in Figs. 7 and 8 and mounted on balloon-tired wheels for running over sand. The axle is welded to the angle-bar brackets, which in turn are bolted to the cradle. The latter tapers to fit the hull just aft of the propeller, and balances the craft nicely so that it is very easy to handle. Finish hull with two coats of enamel and then wax.



Bracket to Attach Outboard Motor to Canoe

This simple bracket will enable you to attach an outboard motor to your canoe or kayak for swift transportation without arduous paddling. Outboard motors of ¾ to 2 hp. are sufficient for powering the average canoe. The bracket consists of a length of pipe fitted at one end with a hardwood block bolted in place to serve as a motor mount. L-hooks to fit under the gunwales attach the bracket to the boat.

Disk Soldered to Bilge Pump Protects Boat



Because some bilge pumps used on small boats have bases with sharply projecting feet, they mar the bottom planking when being used. However, if a metal disk with a large hole in the center is soldered to the feet, it will prevent damage, and will not obstruct the flow of water because of the center hole and the space between the feet. A brass disk is preferred as it will not rust and is not damaged by the action of salt water.

Foot-Powered Catamaran Is Fun →

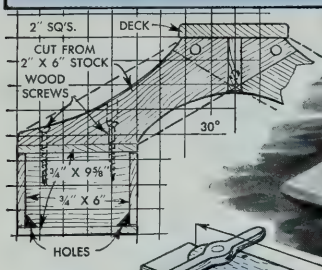
It's great fun to lie on the deck of this homemade catamaran, slip your feet into the toe-clips and paddle over the lake or bay, steering your course with the forward rudder using little effort. Pontoons, of ¾-in. lumber, are joined with nails—preferably galvanized—driven about an inch apart, and are calked with strips of cotton binding tape laid in marine or casein glue, or white lead. Plywood centerboards are screwed on the inside of each pontoon.

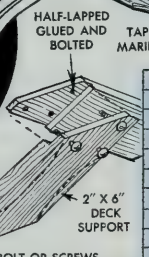
The deck, made from the same material as the pontoons, is supported by two arched cross members of 2-in. lumber cut as shown and half-lapped, glued and bolted together and installed on the pontoons with screws through the two forward bulkheads. A brace running under the deck reinforces it. A stiff crosspiece supports the paddles a few inches above deck level, and on this piece the paddles are hinged. On the drive stroke the paddles swing back against the upper section to which the canvas or leather toe-clips are attached, and on the return, they swing free, dragging across the surface of the water.

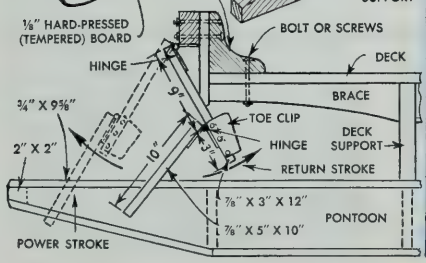
To use the catamaran as a sailboat, the paddles are fastened out of the water, the handgrips are removed from the rudder and a tiller is substituted. The skipper now faces in the other direction, with the rudder at the stern. The mast, tapering from 2 in. at the bottom to 1⅛ in. at the top, is held in a step block on the narrow part of the deck and braced by wire stays made taut with turnbuckles. To furl the sail, the boom is swung up and the sail wrapped around the mast and tied. Several coats of paint carefully applied complete the job and give you a seaworthy boat that can be used for a diving platform, surfboard or craft for an outboard motor as well as a foot-powered raft.

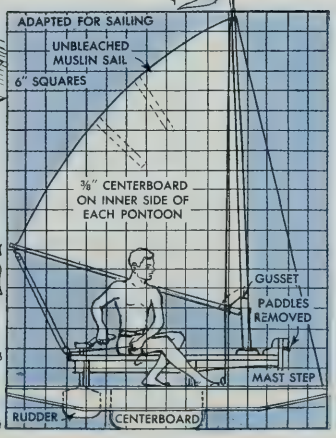
Note in the detail at the lower right of the facing page that two centerboards, one mounted on the inner side of each pontoon, are required when the catamaran is adapted for sailing. A mast step is placed behind mount for paddles.

Fun at the beach with this KICK-KATAMARAN

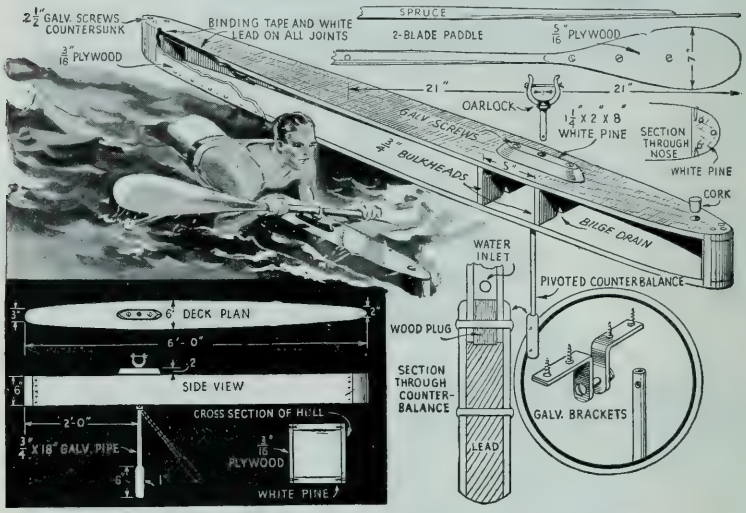






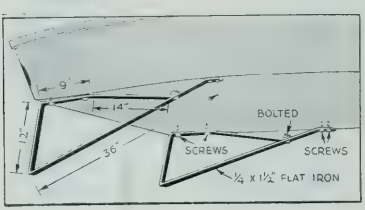


"Feathercraft" Offers New Sport to Swimmers



Propelled half by swimming and half by paddling, these featherweight pontoons will provide plenty of sport at any beach. They are 6 ft. long, tapered and rounded at both ends. Top and bottom are pieces of ¾-in. white pine of exactly the same size and shape. These are screwed to nose and stern blocks and to two bulkheads located under the oarlock. Sides of 3/16-in. plywood are then cut out. It is preferable to use waterproof plywood for this purpose, but if this is not available, ordinary plywood given several coats of paint, especially at the edges, will do. In order to make the pontoon watertight, all joints must be given a liberal application of white lead and a strip of binding tape laid between the contacting surfaces. This should be done at the nose and stern blocks before the top and bottom are screwed on, and similarly when the plywood sides are attached. Note the bilge drain in the bulkheads, which helps to empty the hull of water, should any get inside. The drain hole at the nose is corked when the pontoon is in use. Besides serving to drain out the water, the cork, if not pushed in too tight, will prevent the hull from bursting when the air inside expands under the hot sun, for which reason an air vent is necessary. A beveled block on the top takes an oarlock for a two-blade paddle. To balance the pontoon properly, an 18-in. counterweight is pivoted to galvanized angle-iron brackets, which are screwed to the bottom directly under the oarlock.

Flat-Iron Skids Shield Boat Motor From Submerged Logs



Damage to an outboard motor by having it strike submerged logs and rocks in a shallow lake can be avoided by fitting it with these skids, which act like sled runners to raise the stern over any obstruction. Bolted to the bottom of the boat, the skids are thin enough to offer very little resistance to the forward movement of the boat. Also, if you drag your boat across a narrow strip of land from one lake to another, the skids will be helpful.

"HALF-PINT"

a small simplified sea sled

All-purpose, lightweight boat, made of plywood and powered by a small one-half horsepower gasoline motor, chugs along at about six miles per hour

PLYWOOD, preferably the waterproof kind, a small amount of miscellaneous stock and a tiny gasoline motor are all you need to make "Half-Pint." The original, capable of carrying three persons, was quite a sensation at Balboa Bay, Calif., where even the old boat-builders expressed genuine interest. Built in a garage, it was taken 50 miles for its first dip and has never developed a leak. This little sea sled can be easily carried on your car, and fishermen and tourists will find it ideal for use on remote lakes having no boating facilities. It is only 9 ft. long and so light that two boys can easily carry it. The boat is suitable for the use of any small gasoline engine of the washing-machine type, air-cooled by a fan in the flywheel. The ½-hp. engine which was selected is exceptionally satisfactory because the gas tank is in the base and it is a self-contained unit throughout.

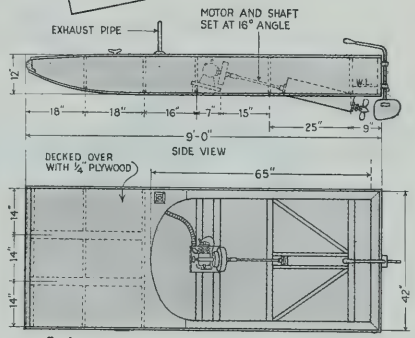


FIG. 1

The extra-wide beam affords ample room for two passengers to sit side by side, and a third can even be carried on the forward deck. Over-all dimensions are given in Fig. 1. The sides are ¾-in. pine. After cutting it to shape, screw on the chine with 1¼-in. flat-head brass screws, spaced about 4 in. apart, when all contacting surfaces have been liberally painted with white lead. The nose is a cross member planed down and rounded as shown in Fig. 3. The sides are fastened to it with two large flat-head screws, countersunk. Apply white lead liberally before screwing down permanently. The transom, or stern piece, is of the same material as the sides, with chine, etc. Put temporary diagonal braces across the top, to keep the structure square, and turn upside down. Apply white lead along the bottom edges and chine, and lay a 1-in. strip of muslin over the joint. Over this place the ¼-in.-plywood bottom. It should be painted on the inside before screwing down permanently. Use ¾-in. brass screws, staggered 3 in. apart, one screw in the side and the next in the chine, alternately. The crossframes should be put in next. Note that there is a bulkhead at the second frame from the nose. When the deck is on, this makes a large watertight compartment.

For the shaft log, or block through which the propeller shaft runs, prepare a pine block as in Fig. 8. A channel in each half takes the propeller shaft. Glue the two blocks together and, when dry, cut diagonally at an angle of about 16 deg.—a 1-in. rise to every 3½ in. of length. Now install the bearings, the stuffing box at the rear and the inboard bearing at the other end. Put the two triangular blocks together with pieces of wood between them

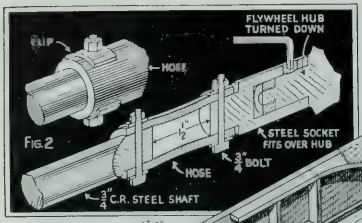


Fig. 2

Fig. 3

Fig. 7

Fig. 4

Fig. 5

Fig. 6

just the thickness of the bottom. Put the propeller shaft through the bearings so that it aligns properly. When the shaft turns freely clamp the block together for drilling bolt holes. The log should then be located in the bottom of the boat. Use white lead and a muslin gasket where the lower half of the log fits against the bottom of the boat. Also apply white lead and cloth gaskets under the bearing flanges where they fit against the ends of the shaft log. Brace with cross members and diagonals on the bottom, inside the boat. White lead is put under all cross members, by the way, and the bottom screwed to them from the underside with ¾-in. brass screws. After the shaft log is in place, the 2 x 4-in. engine supports are installed. A section is cut away so that a ¾-in.-plywood board will set at an angle of 16 deg. when screwed to it. By bolting the engine to this board and moving it forward or backward, the engine and propeller shaft can be aligned accurately. When location is determined, cross members are marked and screwed in place in the assembly.

A deck of ¼-in. plywood, already painted or shellacked, is fitted over the top framing. There should be no raw or unpainted wood anywhere on the entire boat. Connection of the motor and propeller shaft is made as in Fig. 2. Wood bearings boiled in oil have been found cheaper and just as practical as iron ones for the rudder. The edges of the rudder should be carefully streamlined. The false bottom is made in two sections back of the engine and one forward, and is removable. A 5-in., 10-deg.-pitch propeller will be satisfactory. And, having made a first-class hull, don't neglect using the best grade of marine paint for finishing. This will add greatly to the appearance of the boat, especially if the painting is done in two tones.

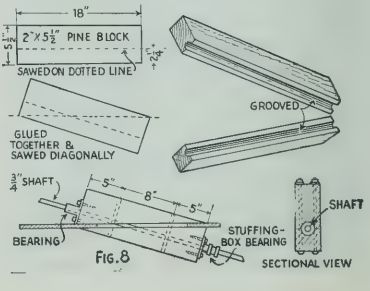
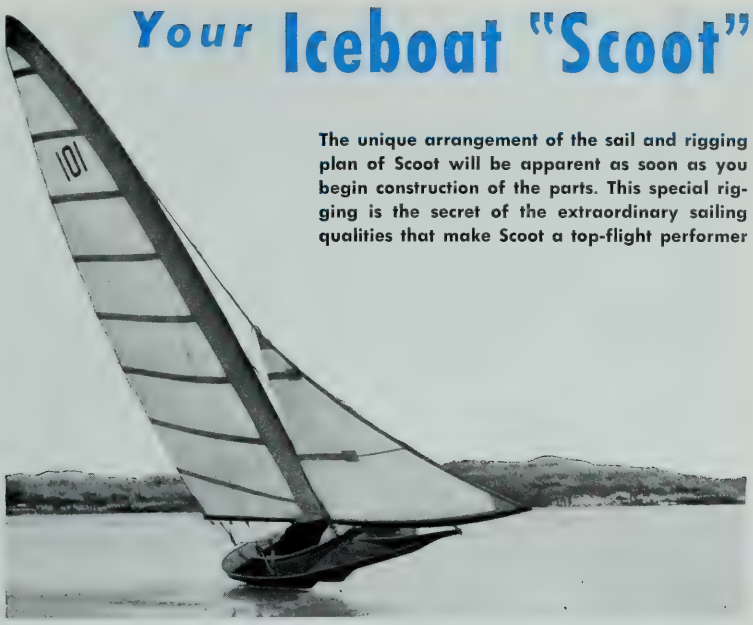


Fig. 8

Your Iceboat "Scoot"



The unique arrangement of the sail and rigging plan of Scoot will be apparent as soon as you begin construction of the parts. This special rigging is the secret of the extraordinary sailing qualities that make Scoot a top-flight performer

FEATURING rudderless steering and a flat, shell-type hull, here's a unique 15-ft. racing iceboat, the original of which dates back historically to early days when it was used in lifesaving work on New Jersey's Great South Bay. Born of the necessity of being able to cross the bay even when it was only partly frozen, Scoot, in addition to its high speed and extraordinary maneuverability, is noted for its ability to take to open water, if necessary, in hurdling large patches of broken ice. Speeds greater than 80 m.p.h., achieved with as many as four passengers, put Scoot in the racing class. As a result of its four-point runner suspension, its maneuverability is extremely flexible, permitting sharp turns without danger of capsizing or skidding. Steered by manipulating a large-size jib sail, Scoot can be held on an arrow-straight course or turned almost literally on a dime.

As designed and built by Bill Harless, noted racing champion, this version of the scooter-type iceboat is the result of prolonged experimentation and development. The hook sail rig used is, in effect, a high-performance airfoil and, because of it, Scoot glides along effortlessly in the mildest breezes and really scoots past competition with a strong wind. The boat is moored by merely tipping it on edge with the sails flat on the ice. Except where modified to simplify construction, the plans presented here were taken directly from the actual boat. Original hardware, which was especially designed and cast in brass, has been replaced with less expensive fittings that can readily be improvised from common parts easily obtainable.

Building the Hull

The first step in building the hull is to draw the mold frames and the plan and profile views full size on heavy building paper, Fig. 3. The plan view is drawn by following the half-width dimensions given in Fig. 4, while the profile and mold frames are drawn by referring to the table of offsets in Fig. 1 and the body plan, Fig. 2. The body plan is an end view of the plan and profile. Note, in Fig. 4, that half-width dimensions are given to the inner face of the inside chine which is the line from which the mold frames are laid off. Offsets are given to the outside of the planking, so remember to deduct the thickness of the planking. In laying out the lines full size, use a long batten to fair out the curves. The text under the heading, "Laying Out Plans,"

beginning on page 162, will tell you how this is done. Considerable tolerance is permissible in establishing the lines as long as you do not exceed the maximum dimensions given in the plan.

The hull is built in an inverted position on a building form, Fig. 5. While the form can be supported in the manner shown, it also can be mounted on regular saw horses. The center deck strake is fastened temporarily to the form with C-clamps and screws and then the mold frames are set on the strake at the station points as in Fig. 7. Note here that the mold frames are leveled carefully and are held in position laterally with braces running to the floor. Next, inside chine stringers, which are ¾ in. thick, are nailed temporarily to the ends of the mold frames. The ends of the chines are pulled inward at the bow and stern with rope slings and are fastened permanently to the breasthook and stern block with brass screws. After this, a ½ x 6-in. keel apron is tacked temporarily to the mold frames and fastened permanently to the breasthook and stern block, as shown in the diagram, Fig. 7.

Permanent frames consisting of bottom timbers and deck beams are made next. While best construction calls for steaming and bending these pieces in jigs, they can be bandsawed to shape if steaming facilities are not available. The permanent frames are installed by placing them 9 in. apart on the strake and holding them in position with two temporary longitudinal battens. Then they are screwed to the deck strake, chines and keel apron. With this done, the inside chine pieces are beveled to conform with the frame lines and then notches are cut in the chines for chain plates, Fig. 8.

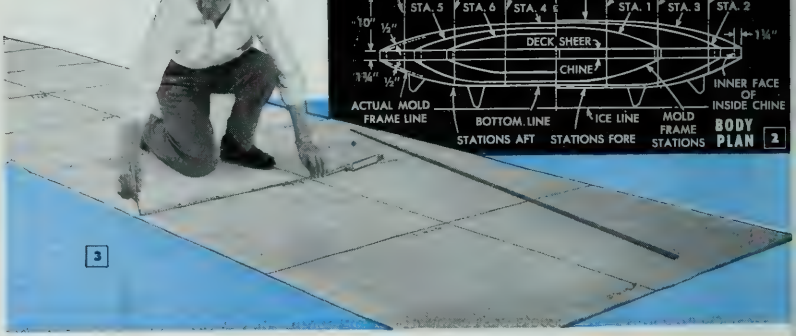
Now the bottom planking is laid. The photo, Fig. 6, shows the planking partially completed. As the hull does not have to be absolutely watertight, calking is not required. However, the planks should be shiplapped, or tongued and grooved at the joints. Planking is begun at the keel apron, and, when finished, is trimmed flush with the outer edge of the inside chines.

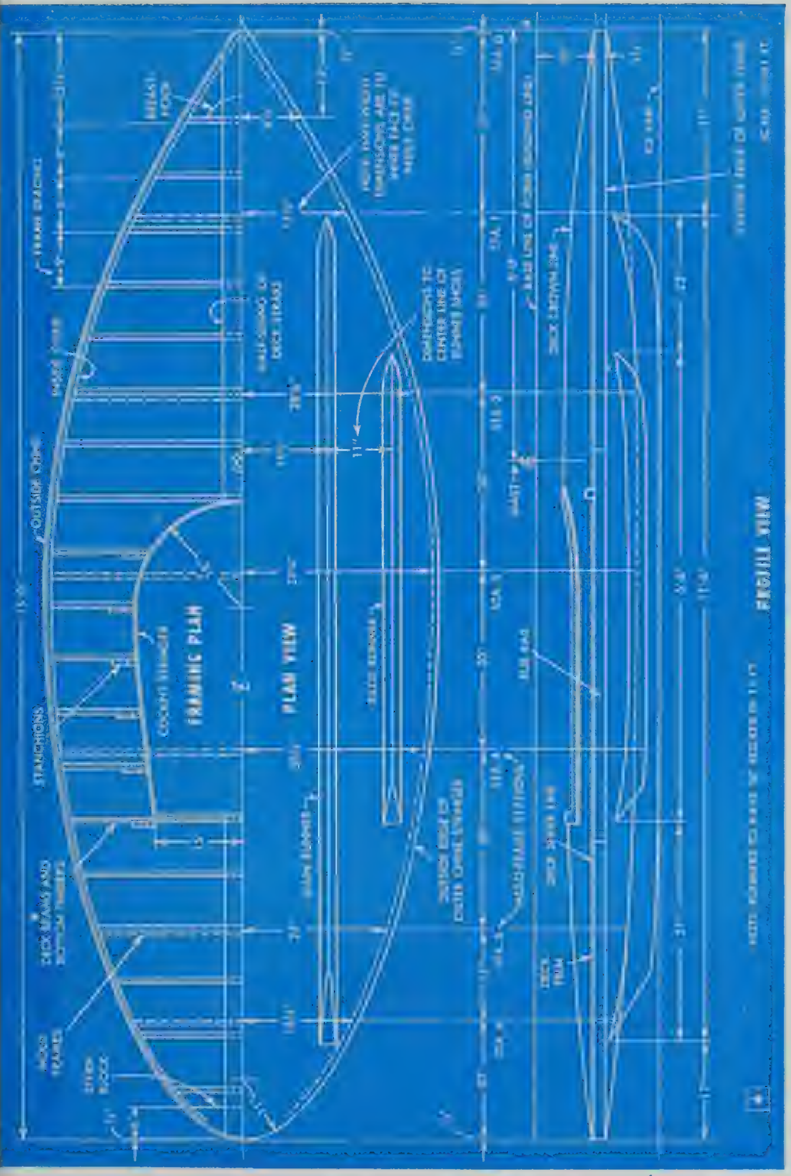
The hull can now be removed from the form. The mold frames and their bracing are removed and the hull is supported right side up on saw horses. The main and bilge-

1 TABLE OF OFFSETS—Measurements From Base Line to Bottom of Hull*

STATIONS	Bow	1	2	3	4	5	6	Stern
Deck crown line	0-10-0	0-6-0	0-5-2	0-5-0	0-5-2	0-6-0	0-7-2	0-10-0
" buttock 9" out	——	0-6-6	0-5-3	0-5-0	0-5-3	0-6-2	0-7-3	——
" buttock 18" out	——	0-9-6	0-6-2	0-5-5	0-6-1	0-7-4	0-9-3	——
" buttock 27" out	——	——	0-9-0	0-7-4	0-10-1	——	——	——
Deck sheer line	0-10-0	◄ STRAIGHT ►						0-10-0
Chine line	0-11-6	◄ STRAIGHT ►						0-11-6
Bottom buttock 27" out	——	——	1-0-7	1-2-4	1-1-7	——	——	——
" buttock 18" out	——	0-11-7	1-4-1	1-4-7	1-4-3	1-3-0	1-0-1	——
" buttock 9" out	——	1-3-2	1-4-5	1-5-0	1-4-5	1-3-6	1-2-2	——
" at center line of hull	0-11-6	1-3-6	1-4-5	1-5-0	1-4-5	1-3-6	1-2-2	0-11-6

*** As the hull is built in an inverted position, measurements or heights are given from the base line, Fig. 2, to the bottom of the hull. Dimensions are in feet, inches and eighth inches to the outside of the planking. All plus or minus dimensions are to be converted as required when laying out full-scale lines. Half-width dimensions for mold frames are to inner face of inside chine**




FRAMING PLAN
PLAN VIEW
PROFILE VIEW
STANCHIONS
OUTSIDE CHINE
DECK BEAMS AND
COCKPIT STRINGER
11"

runner clamping pieces come next. These are fastened to each frame and holes are drilled in them for the runner bolts. The holes are located either aft or forward of each bottom timber as indicated in Fig. 10. Do not pass bolts through bottom timbers.

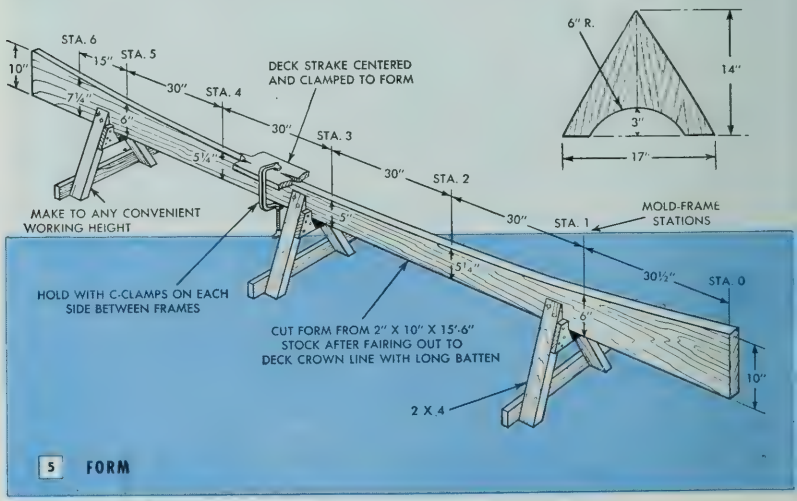
The mast step block is fastened to the bottom timbers as shown in Figs. 9 and 11. The mast step itself is a length of ¾-in. galvanized pipe. This is threaded into a standard pipe flange and the flange is screwed securely to the mast step block. The pipe should be just long enough to pass through the mast partner, which provides an upper step, and the deck strake, coming flush with a flange screwed to the strake.

Cockpit framing and the stanchions which support it are installed next. Note that stanchions also are installed at the center of the frames, fore and aft of the cockpit. The ends of the stanchions are cut to lap the face of the frames as shown in the detail above Fig. 12. With all interior framing completed up to this point, the decking is laid. Narrow planks, 1¼ in. wide, make this a simple job. The same procedure is followed here as was used in planking the bottom, working outward from the deck strake and trimming off the planks flush with the inner chines. For a neat job, countersink all screws and fill with wood putty. As will be noted in Figs. 8 and 11, the face of the inside chines and the edges of the deck and bottom planking are covered with an outside chine piece, ½ in. thick, which also is beveled off flush with the deck and bottom planking. Before fastening the outside chine, the rub rail should be flanged over and tacked to the inside face of the chine. The rub rail, of brass or copper, is applied to the chine from the mast station to the aft end of the cockpit and prevents scuffing when the hull is heeled over. After the outside chine has been fitted, the sheer trim is attached. This is set inward about ¼ in. and covers the joint between the decking and the outside chine. Completion of the hull involves fitting a coaming strip around the cockpit and installing the flooring, Fig. 9. Note that the screws in the floor boards are driven in countersunk holes and puttied over.

The bilge and main runners may be shaped from solid stock or built up of two or more laminations. All runners have a slight curve or rocker, ⅝ in. in 11 ft. They are bolted to the hull according to the dimensions given in the plan and profile views, Fig. 4. Note in Figs. 10 and 12 that the runner shoes, which are angle iron, toe inward. This is important and has a definite bearing on the performance of the iceboat. The shoes are fastened to the runners with screws, spaced 6 in. apart and staggered on each side.

Fitting the Rigging

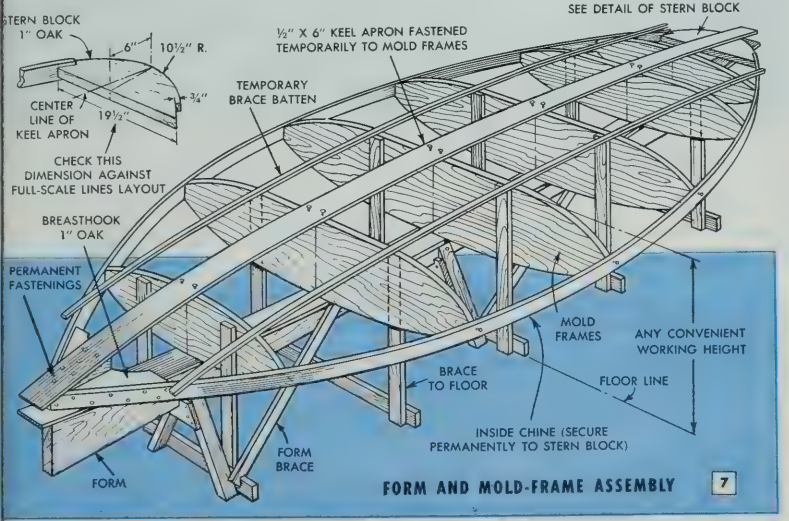
The first step in fitting rigging is laying out and bandsawing the horn, Fig. 13. The horn should be very carefully fitted to the curve of the deck, and then tapered and chamfered. The ⅝-in. bolt which holds the

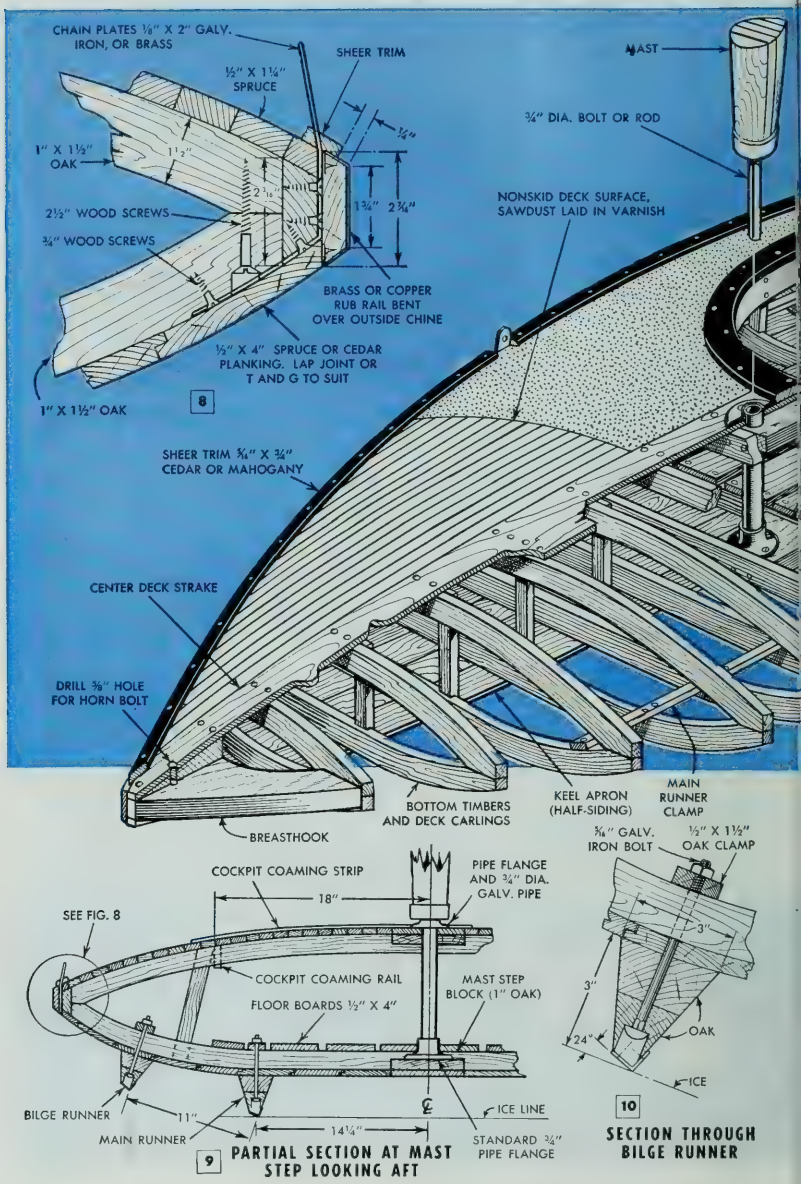


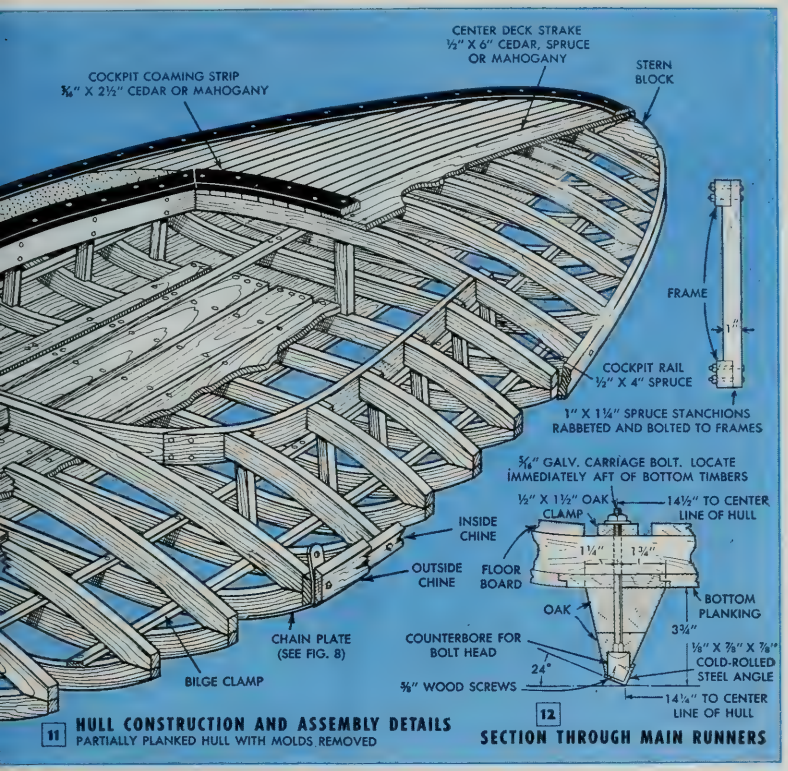
horn in place, and at the same time makes it readily detachable, passes entirely through the breasthook. The aft end of the horn is held in a U-shaped clip, Fig. 16, which is screwed to the deck. The smooth round-bottom notch for the jib-boom ring fitting, Fig. 16, is formed by sawing down the sides, and smoothing with a wood rasp and fine sandpaper. A standard tiller-rope guide for the mainsail sheet, Fig. 22, a 7-in. traveler and cleats for the main and jib-sail sheets are the only other permanent deck fittings.

Original Scoot under construction. Note that the bottom planking is being applied after deck planking, a reverse procedure used by builder. It was found, however, more practical to plank the hull as described

The mainmast, Fig. 14, is built up to the required size by laminating selected spruce in a rectangular cross section, using both ¼ and ¾-in. stock. By constructing a bending jig on a level floor of sufficient length, the mast can be built up in one operation. Stock for the hook section must be steamed before bending. Rip the ¾-in. stock for the lower section to 3¼ in. in width and glue and clamp it in the improvised jig with C-clamps. Use waterproof glue. The ends of the outside members project about 32 in. (See note on the upper detail in Fig. 14.) As the ¼-in. laminations are built up in the jig, make sure that all joining flat surfaces are coated liberally with waterproof glue and that the C-clamps are equally spaced and tightened to a uniform tension. Allow the glued-up mast to dry 24 hours before removing the clamps. Now, note from Fig. 14 that the

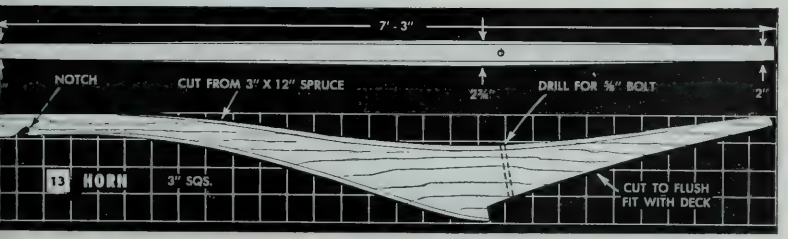


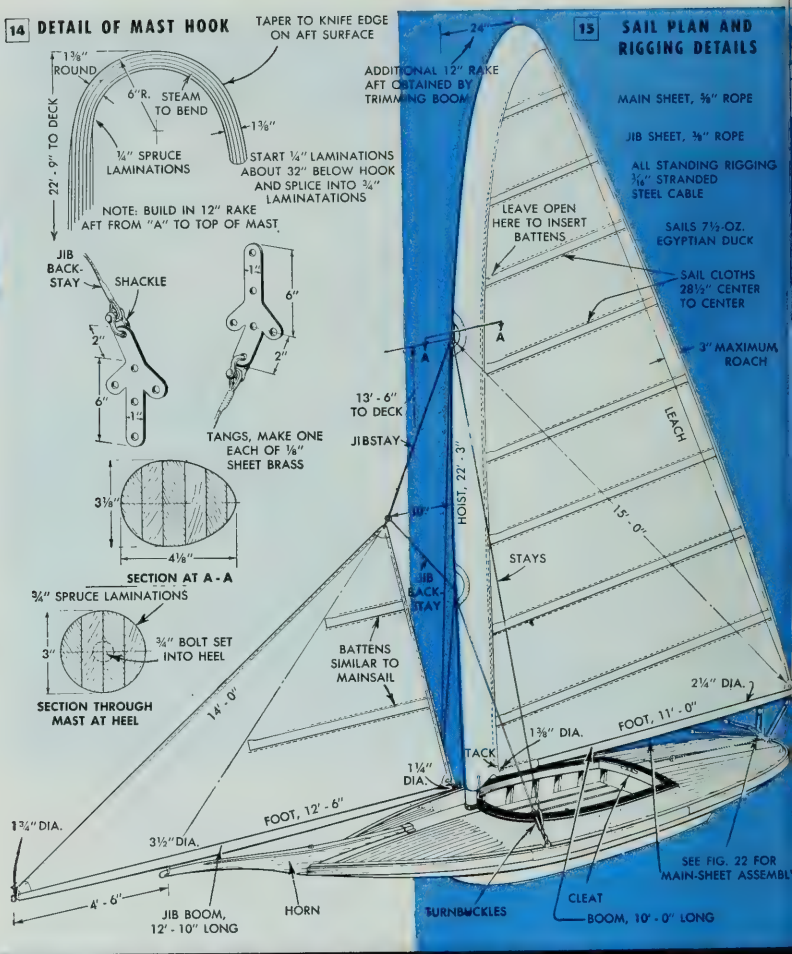

CHAIN PLATES ⅛" X 2" GALV. IRON, OR BRASS
SHEER TRIM
½" X 1¼" SPRUCE
¼"
1" X 1½" OAK
1½"
2 1/16"
1¾"
2¾"
2½" WOOD SCREWS
¾" WOOD SCREWS
BRASS OR COPPER RUB RAIL BENT OVER OUTSIDE CHINE
½" X 4" SPRUCE OR CEDAR PLANKING. LAP JOINT OR T AND G TO SUIT
1" X 1½" OAK
8
MAST
¾" DIA. BOLT OR ROD
NONSKID DECK SURFACE, SAWDUST LAID IN VARNISH
SHEER TRIM ¾" X ¾" CEDAR OR MAHOGANY
CENTER DECK STRAKE
DRILL ⅜" HOLE FOR HORN BOLT
BREASTHOOK
BOTTOM TIMBERS AND DECK CARLINGS
KEEL APRON (HALF-SIDING)
MAIN RUNNER CLAMP
COCKPIT COAMING STRIP
18"
PIPE FLANGE AND ¾" DIA. GALV. PIPE
SEE FIG. 8
COCKPIT COAMING RAIL
MAST STEP BLOCK (1" OAK)
FLOOR BOARDS ½" X 4"
BILGE RUNNER
11"
MAIN RUNNER
14¼"
℄
ICE LINE
STANDARD ¾" PIPE FLANGE
9
PARTIAL SECTION AT MAST STEP LOOKING AFT
¾" GALV. IRON BOLT
½" X 1½" OAK CLAMP
3"
3"
24"
OAK
ICE
10
SECTION THROUGH BILGE RUNNER

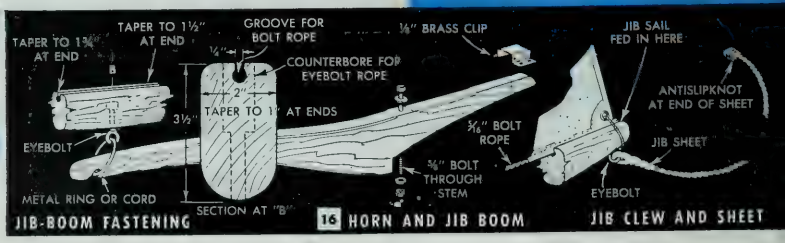


mast is round at the heel, but that it changes gradually to a pear shape at section A–A, Figs. 14 and 15, and then back to a round section at the forward turn of the hook bend. From this point the section again changes to an elongated oval with a knife edge on the after turn of the bend, Fig. 14. Shaping of the mast is done by hand with a spokeshave. It is then sanded smooth and finished with at least two coats of spar varnish.

In the original rig, both the jib and the mainsail booms were of one piece cut from solid stock and grooved along the length for the bolt rope, Figs. 16 and 21. The mainsail boom is circular in section, but the jib

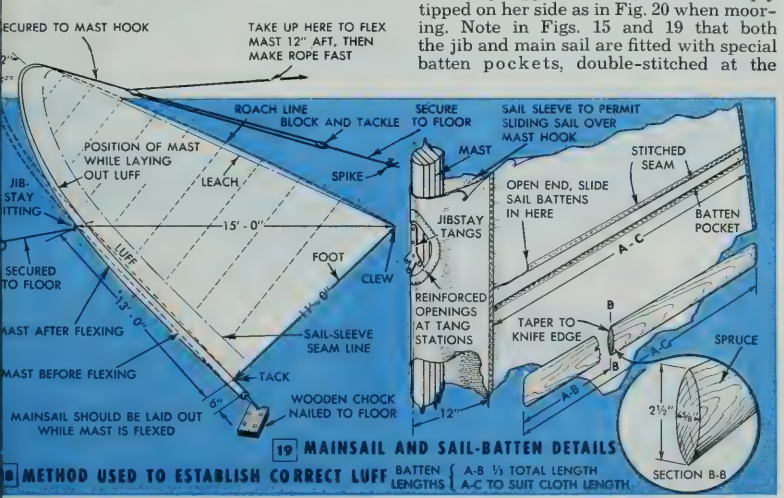



14 DETAIL OF MAST HOOK
TAPER TO KNIFE EDGE ON AFT SURFACE
1⅜" ROUND
6"R. STEAM TO BEND
1⅜"
22'-9" TO DECK
¼" SPRUCE LAMINATIONS
START ¼" LAMINATIONS ABOUT 32" BELOW HOOK AND SPLICE INTO ¾" LAMINATATIONS
NOTE: BUILD IN 12" RAKE AFT FROM "A" TO TOP OF MAST
JIB BACK-STAY
SHACKLE
2"
6"
1"
1¼"
6"
2"
TANGS, MAKE ONE EACH OF ⅛" SHEET BRASS
3⅛"
4⅛"
SECTION AT A-A
¾" SPRUCE LAMINATIONS
3"
¾" BOLT SET INTO HEEL
SECTION THROUGH MAST AT HEEL
14'-0"
1¾" DIA.
FOOT, 12'-6"
3½" DIA.
4'-6"
JIB BOOM, 12'-10" LONG
HORN
15 SAIL PLAN AND RIGGING DETAILS
24"
ADDITIONAL 12" RAKE AFT OBTAINED BY TRIMMING BOOM
MAIN SHEET, ⅜" ROPE
JIB SHEET, ⅜" ROPE
ALL STANDING RIGGING 3/16" STRANDED STEEL CABLE
LEAVE OPEN HERE TO INSERT BATTENS
SAILS 7½-OZ. EGYPTIAN DUCK
SAIL CLOTHS 28½" CENTER TO CENTER
3" MAXIMUM ROACH
A
A
13'-6" TO DECK
JIBSTAY
HOIST, 22'-3"
LEACH
15'-0"
STAYS
JIB BACK-STAY
BATTENS SIMILAR TO MAINSAIL
2¼" DIA.
FOOT, 11'-0"
1⅜" DIA.
TACK
1¼" DIA.
SEE FIG. 22 FOR MAIN-SHEET ASSEMBLY
TURNBUCKLES
CLEAT
BOOM, 10'-0" LONG


TAPER TO 1¾" AT END
TAPER TO 1½" AT END
GROOVE FOR BOLT ROPE
¼"
⅛" BRASS CLIP
JIB SAIL FED IN HERE
COUNTERBORE FOR EYEBOLT ROPE
2"
3½"
TAPER TO 1" AT ENDS
ANTISLIPKNOT AT END OF SHEET
⅜" BOLT ROPE
JIB SHEET
EYEBOLT
⅜" BOLT THROUGH STEM
EYEBOLT
METAL RING OR CORD
SECTION AT "B"
JIB-BOOM FASTENING
16 HORN AND JIB BOOM
JIB CLEW AND SHEET

When fully rigged, Scoot looks like this. Note the roomy, shallow cockpit and the novel boom tackle for trimming the mainsail to suit wind conditions. Foot of the mainsail is attached to boom with bolt rope

boom tapers each way from the ring fastening and the section is rectangular with rounded corners, Fig. 16. However, it is easier to form the special undercut grooves if the booms are each made in two pieces and glued together after forming a round-bottom groove, or flute, in each piece. When the pieces are glued together, this will result in a single deep groove with a circular undercut as in the sectional view, Fig. 16. Finish the booms by sanding smooth and coating with spar varnish. Making the main and jib sails is a job for a professional sailmaker unless, of course, the builder has had experience in this work. Note from Fig. 21 that the mainsail boom is carried in a pocket sewed onto the foot of the mainsail. There is no gooseneck as in conventional rigging. Also, the builder will have to work closely with the sailmaker in establishing the luff of the mainsail, Fig. 18. The mast must be flexed with a tackle block in the manner shown, and it must be held in this position while laying out the luff of the mainsail. The luff, or leading edge, is in the form of a pocket, or boot, large enough to slip over the mast, Figs. 15, 18 and 19. No sail track is used, the luff being held taut by a short lashing made fast to a downhaul cleat, Figs. 17 and 21. Neither can the mainsail be raised or lowered once it is fully rigged. Instead, Scoot is simply tipped on her side as in Fig. 20 when mooring. Note in Figs. 15 and 19 that both the jib and main sail are fitted with special batten pockets, double-stitched at the

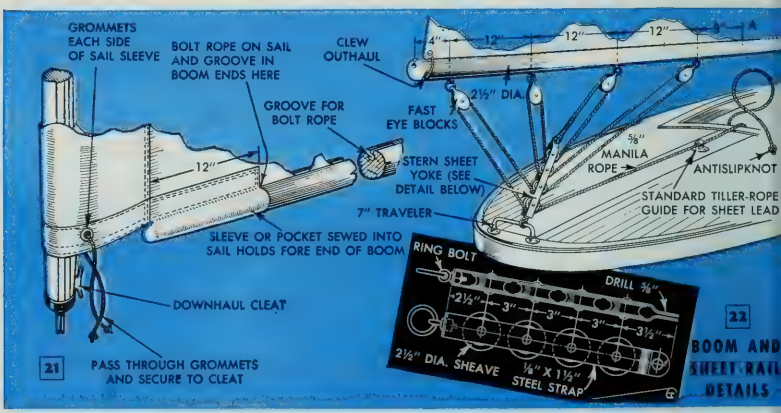


The mainsail cannot be raised or lowered once it is fully rigged. When not in use for short periods, Scoot is tipped on its side

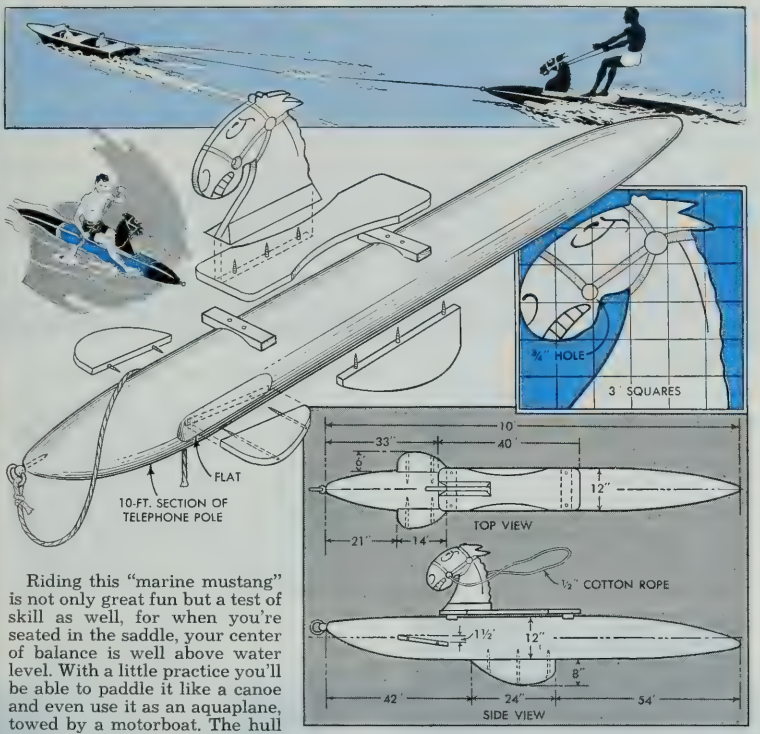
edges. The pockets have open ends, Fig. 19, so that the battens may be inserted and removed easily. The battens are of selected spruce, worked down to an elongated oval section with sharp edges. In addition, each batten is tapered slightly both ways from section B-B, Fig. 19, to a blunt edge at the ends. The multiple-sheave sheet yoke, Fig. 22, is another special part and must be made up according to the detail. It is essential that all sheaves turn freely. The yoke is attached to the traveler by means of a ring bolt as shown. One end of the sheet is passed through the drilled ends of the yoke straps and is seized to the standing part. Then the free end of the sheet is passed through four eye blocks attached to the boom on the spacings indicated and successively through the four sheaves to make the novel dual-purchase tackle shown in Fig. 22. Tie an antislipknot in the end of the sheet. Then, check for free running of the rope through the blocks. This arrangement of boom and sheet-rail rigging gives the mainsail a strong mooring, yet permits quick changes necessary at the high speed of ice yachting.

EVOLUTION OF "SCOOT"

Unique in man's long search for ways to improve wind-driven ships, the scooter-type iceboat first came into being on the Great South Bay of the New Jersey coast. Born of necessity when a means was needed to cross the bay even when only partly frozen, the forerunner of Scoot was put to work in lifesaving service. It at once proved superior to the flat-runner punts which had been piked across the ice and sculled through water at arduously slow speeds. After a few runs, a small sprit was added to the sail rig of Scoot. From sprit to gaff was but a step, followed by the Gunther and modified Marconi and, finally, by the double-luff sail and hook mast. This led to rigging a blade on an oar handle to serve as a rudder, and later the addition of a jib. By carefully balancing the rig, it was found that steering could be done entirely by manipulating the jib. Then came the changeover from flat to angle-type runners which helped hold a straight course when sailing on hard ice. To improve the jib, a boom was laced along the foot. Later, the lashing was moved aft of the jib boom to permit the jib to swivel. It was then that the scooter came of age in both speed and maneuverability, and soon the baymen began racing their unusual craft, joining sportsmen in organized competition.

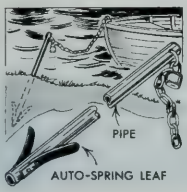


PUT TO SEA ON THIS GALLOPING "MARINE MUSTANG"



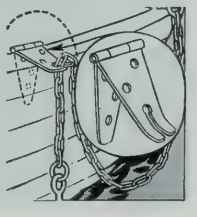
Riding this "marine mustang" is not only great fun but a test of skill as well, for when you're seated in the saddle, your center of balance is well above water level. With a little practice you'll be able to paddle it like a canoe and even use it as an aquaplane, towed by a motorboat. The hull or float is a 10-ft. section of discarded telephone pole. With adz, drawshave and plane the ends are streamlined as indicated, then a towing ring is installed in the tip. Two cleats are mortised into the top for deck supports, and a pair of planing fins of ¾-in. stock attached at an angle on the sides by long lag screws. The keel is secured in the same manner. The head is scrollsawed from pieces of ¾-in. material held together by long dowels or ¼-in. bolts running across the grain to prevent splitting, and braced with triangular cleats.

Stake For Tying Boat to Bank



A self-anchoring stake for rowboats consists of a length of pipe having two pieces of auto-spring leaf bolted to the lower end to form wings. As the stake is driven, the wings spread and grip.

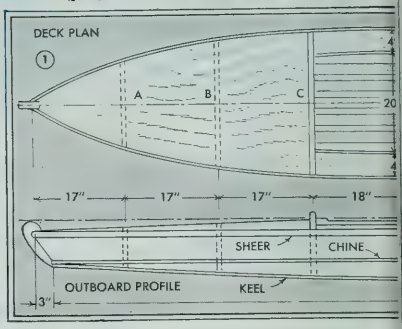
Holder Supports Boat Anchor



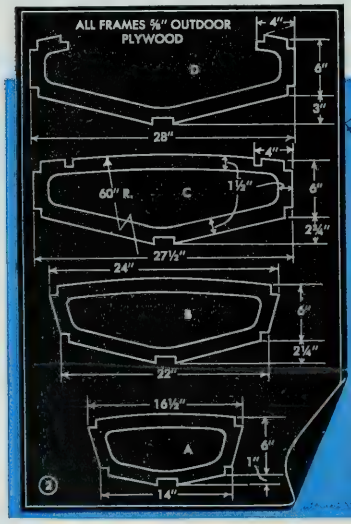
This simple holder supports a boat anchor a few inches off the bottom for frequent changes of position. It is a hinge screwed to the inside of the boat and slotted to take the anchor chain.

"Skimmer" A STURDY

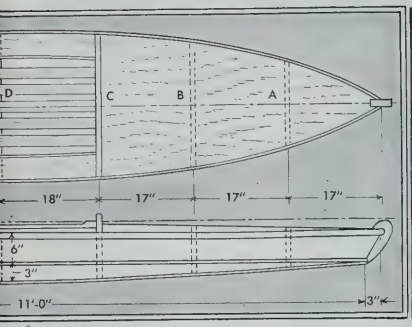
You can put a kayak together in no time — it's not a lengthy all-one-season boatbuilding project

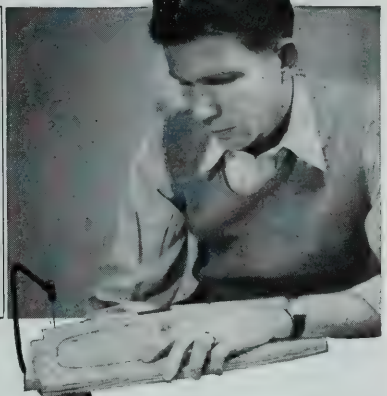


THIS KAYAK is staunch and seaworthy because it's built of waterproof plywood over a conventional frame. Sides are vertical and only 6 in. high from the bottom edge of the chine to the top edge of the sheer batten, but this gives enough freeboard to keep off moderately rough water. Fig. 1 gives the deck and profile plans. Start building by laying out the frames full size on heavy brown paper, following the dimensions in Fig. 2. Then transfer the outlines to ⅝-in. waterproof plywood, making duplicates of frames A, B and C. Saw to the outlines with a jigsaw. Where plywood is not used, make frames as in Fig. 4. Cut ¾ x 1-in. notches for the chine and sheer battens and a ¾ x 2-in. notch for the keelson in each frame. Make a rough frame or "building board" on which you can assemble the frame of the kayak upside down. Cut out the stem and stern parts, the cutwater, filler blocks and knees as duplicates, detail G of Fig. 3. Then assemble on the building board with frames, stem and stern parts, keelson and the chine and sheer battens fastened with glued and screwed joints. Use galvanized screws for joining the frame. Before the glue dries make sure the frames are square and that the assembly is level. Note also from detail A in Fig. 2 the fairing on the chine, sheer batten and keelson. This must be done carefully with a plane so that the deck, sides and bottom will lay properly. Fit the plywood sides first, then coat the chine with marine glue and lay on ½-in.

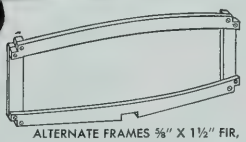


PLYWOOD KAYAK





binding tape as indicated. Apply marine glue to the sheer batten also. Then screw the sides in place. Many builders make the same joint at the chine and keelson. Either way, apply marine glue liberally and uniformly. Space the screws the same as on the sides. This leaves only the deck, coaming and false bottom to be fitted. The splashboards, Fig. 3, should be bandsawed to the exact curvature of the deck. One effective color combination is cream or white on the sides, Chinese red on the bottom, and other parts natural color.



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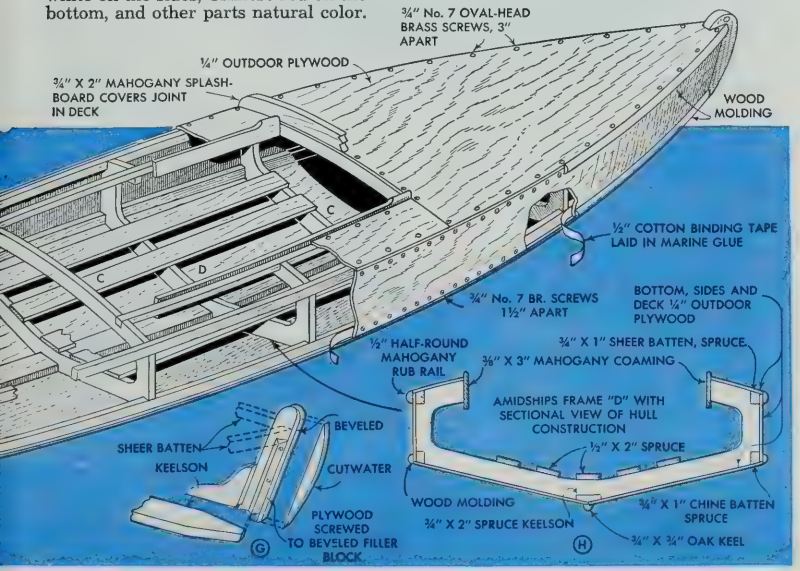
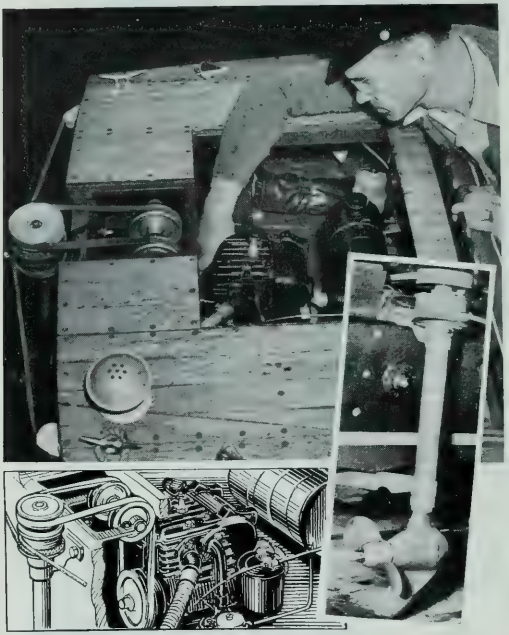


Small Boat Driven and Steered by Washing-Machine Motor



A light, economical inboard motor can be made of an air-cooled engine of the washing-machine type belted to the shaft-and-propeller assembly of a discarded outboard motor. An unusual feature is that the driver can bring the boat to a complete stop and back it up simply by turning the steering wheel. This is possible because the rudder rope is wound around the outboard shaft housing, making it possible to rotate the propeller through a complete circle. The stock engine muffler, which is mounted on an exhaust pipe outside the boat, reduces the usual outboard noise. The engine is cooled adequately by means of ventilating holes drilled through the forward bulkhead. The propeller-shaft assembly is pivoted to the boat stern by means of suitable brackets as shown in the lower right-hand detail. A pulley of a size to rotate the propeller at three times the engine speed is fitted to the upper end of the propeller shaft, and is belted to the engine, the belt running over two idler pulleys as shown in the lower left-hand detail.

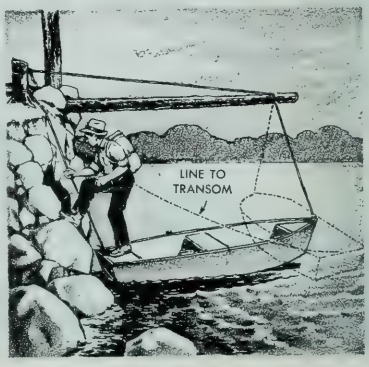
This motor is especially suited to boats from 6 to 8 ft. long. Larger boats may be too heavy for efficient operation.

Stopping Outboard Motors Properly

Do not shut off your outboard motor while it is running at high speed as this results in fouled spark plugs and hard restarting. Instead, slow the motor down to trolling speed for half a minute or so before stopping. This will burn out excess oil from the combustion chambers.

Log Boom Protects Small Boat From Damage on Rocks

To avoid damaging a boat tied up on a rocky bank, set a wooden pole into the bank to act as a boom to keep the boat away from shore. You can tie the boat directly to the outer end of the pole and use a small line to swing the transom end toward shore for boarding, as indicated at the right, or you can give the anchor rope a couple of turns around the outer end of the pole and bring the rope inshore, tying it to a stake or tree upstream to serve as a brace for the boom. To enter a boat moored by this method, just loosen the anchor rope and let the boom swing downstream until the boat comes in close enough to board.



PART 8

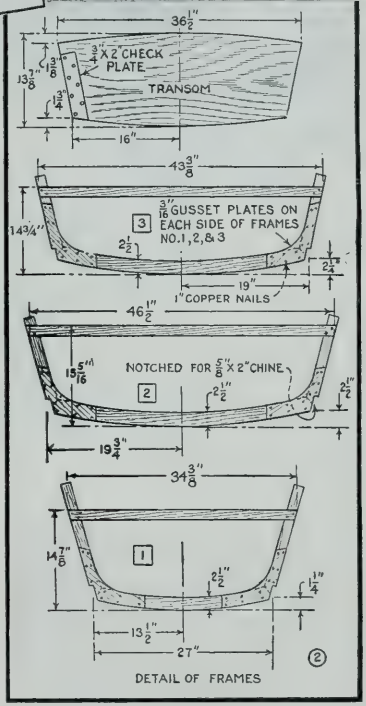
Training "Ships" for Young Sailors

"Sea Scout"

The Biloxi-Type Dinghy

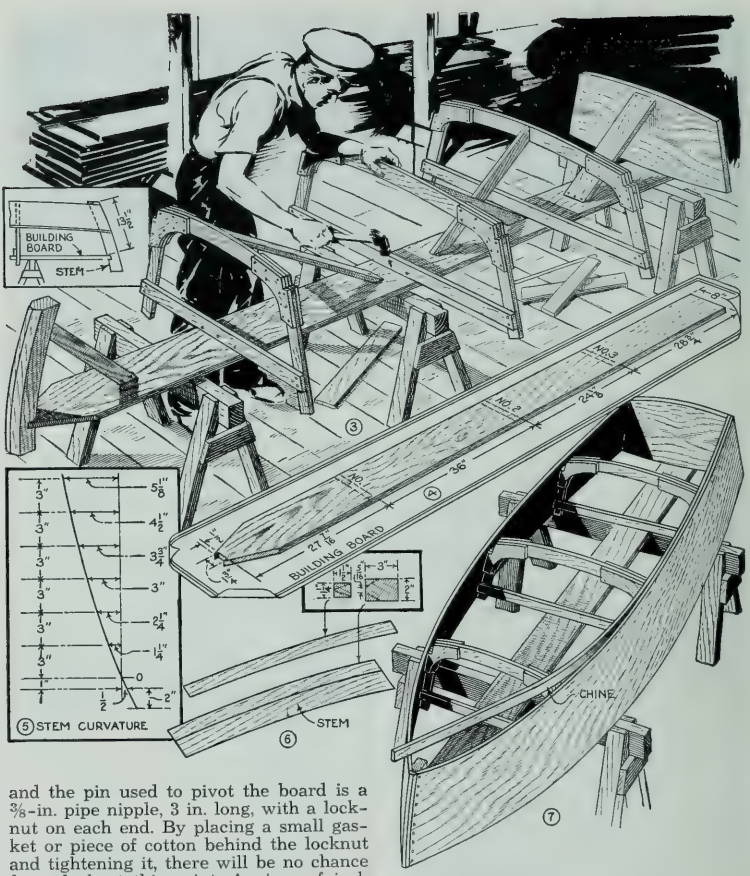
SEA SCOUT, the Biloxi-type dinghy, is not only seaworthy, but also very easy to build. Look over Figs. 1 and 2, which detail the frames and stern board, or transom. There are several points to keep in mind before you begin cutting the parts: The lower cross members of all frames are cut to the same radius; the top crosspieces are a given distance above the lowest point of the curved member, and the frame uprights are joined to the curved members with an angle joint housed in gusset plates, as in Fig. 2. With the frames, stern board and building board made, the work on the hull is well along.

You start assembling the boat by placing the building board on two saw horses as in Fig. 3. The lines marked on the building board, Fig. 4, indicate where to place the frames. These are placed upside down and the center line of the building board must match up with that on the frames. Place frames Nos. 1, 2 and 3 along the lines and fasten through the building board with 8d common nails or 1½-in. screws. A diagonal brace supports each frame, Fig. 3. After the frames have been attached, the sides should be fastened to the stem, Fig. 6. This can be done before mounting the stem on the building board, although it is shown mounted with the frames in Fig. 3. If the sides are built up of several pieces, you simply screw the two lower planks to the stem, but should the sides be made up of narrow planks, the first plank on the lower side should be at least 8 in. wide. When building up the sides you can use shiplap construction which will eliminate battens. The stem is fastened to the sides at the zero (0) line, Fig. 5. Use 1½-in. No. 8 flat-head brass screws spaced about 1½ in. apart, in a staggered row. In Fig. 3 is a detail showing the exact distance from the lower edge of the boat to the building board. By making this allowance on the stem the building board will remain straight, holding the frames so that the lower edges will be in line with the side planks. Now that the stem is in place with the sides attached, you may continue by bending the sides around the frames and holding them in place with a piece of rope. Fasten the sides to the frames with 1½-in. No. 8 flat-head brass screws. The transom is also fastened with 1½-in. flat-head brass screws driven into the check plate and 2-in. screws driven into the end grain of the transom. Fig. 16 shows the offsets and also the exact positions of frames Nos. 1, 2 and 3. Be sure to mark these positions on the sides before bending the latter into position around the frames. The lines are drawn at right angles to the base line and serve as a guide to placement of the frames in an upright position. Move the temporary braces if necessary to bring the frames into the proper position. Now the second and third planks are placed on each side. The shiplap joints are fastened with



⅞-in. copper tacks spaced 2½ in. apart and clinched across the grain. Use marine glue to make the joint waterproof. When the sides are fastened, the next step is to insert the chines as in Fig. 7. Chines are fastened to the frames with 2½-in. No. 8 flat-head brass screws and to the sides with 1¼-in. No. 6 flat-head brass screws spaced 1½ in. apart in a staggered row. Then fair off the sides, transom and stem, a job which must be done carefully to avoid leaks. At this point, select the type of bottom construction. If it is to be the batten-seam type, battens must be mortised at the proper places and the planks fastened to the battens with 1¼-in. copper nails spaced 2 in. apart and clinched. If you use the shiplap type, Fig. 12, rabbet the edges of the planks and fasten them together with ⅞-in. copper tacks spaced 2 in. apart and clinched. In either case, bore holes for the tacks, as otherwise the wood is likely to split. Use one ¾ x 6-in. plank as the center plank, Fig. 10. If you can get them, four ½ x 8-in. planks will then finish the job. The planks are fastened to the frames with 1¼-in. No. 6 flat-head brass screws, except the center plank, where 1½-in. No. 8 flat-head screws are used. Screws in the chines and along the outer edges of the boat are spaced 1½ in. apart in a staggered row. Use 1¼-in. No. 6 flat-head brass screws along this line, as well as into the lower edges of the transom.

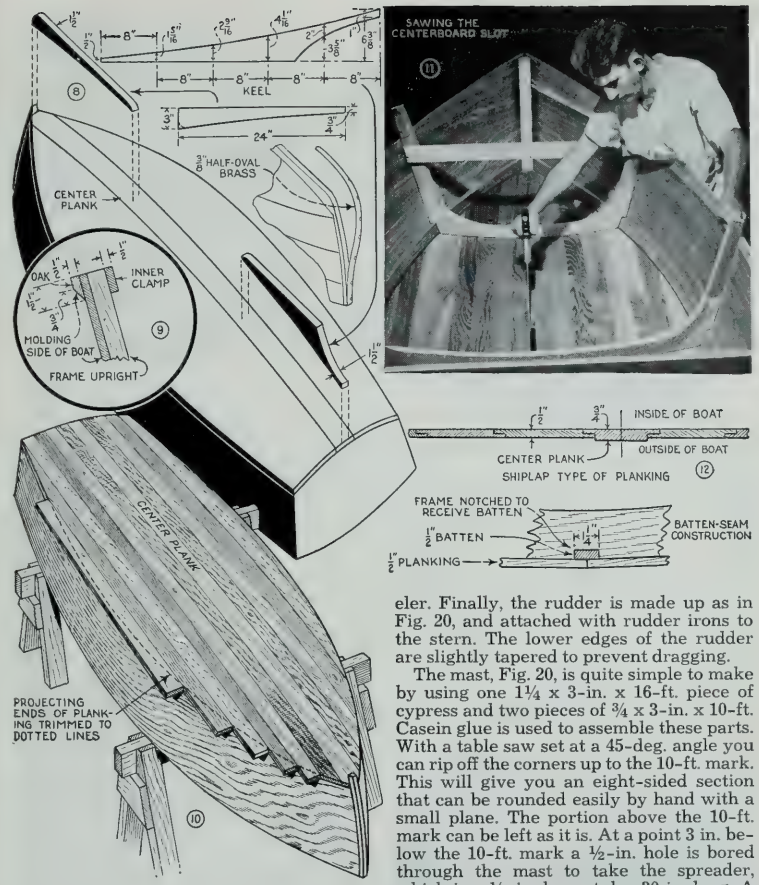
This done, the boat is turned over and the centerboard installed. Make up the centerboard well or casing as in Fig. 15. The oak king posts are fastened to the casing with 1½-in. No. 8 flat-head brass screws, spaced 1½ in. apart. The casing should fit snugly against the bottom of the boat, and should be notched out at the after end to fit over the No. 2 frame. A ¾-in. slot is cut in the boat bottom along the centerline as in Fig. 11, the slot being the same length as the opening in the casing. The slot is covered with a gasket made of heavy muslin and coated with marine glue to insure a watertight joint. The casing is fastened to the bottom with 2-in. screws placed 2½ in. apart. The iron centerboard, Fig. 17, has a ¾-in. hole drilled 3 in. up from the bottom edge and 3 in. in from the side as shown. A hole is bored in the centercase with an 11/16-in. bit



and the pin used to pivot the board is a ⅜-in. pipe nipple, 3 in. long, with a locknut on each end. By placing a small gasket or piece of cotton behind the locknut and tightening it, there will be no chance for a leak at this point. A piece of jack chain is used to raise and lower the board, a pin made of ¼-in. brass rod being slipped through the chain to act as a stop.

The cross member of No. 2 frame is now removed and the seat, Fig. 16, put in place. The seat fits over the lower end of the casing and notches into the uprights of the No. 2 frame on each side. This joint beneath the seat must be watertight as it is near the level of the water on the outside. A cap of ⅜-in. material, 3 in. wide, is bent over the curved portion of the casing.

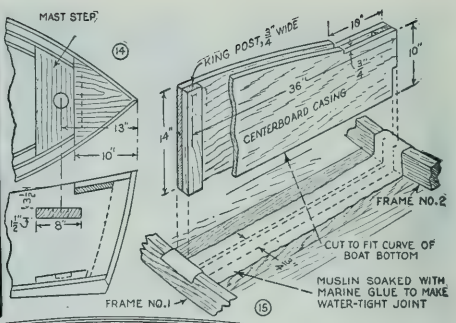
The breasthook, Fig. 14, is made of two pieces of wood with the grain running at right angles. The mast partner, cut from 1½-in. material, is fastened through the sides with 2-in. screws. Now screw the stern knees in place and put the inner clamps in position, Fig. 16. The knees are fastened with 2-in. No. 8 flat-head brass screws and the inner clamps with 1½-in. No. 8 screws. Between the sides and the clamps, the filler blocks, Fig. 16, must be placed. These are made of 1½-in. material, 2 in. long, with the exception of those between No. 2 and No. 3 frames, which are 6 in. long and drilled for the oarlock sockets. The boat is now turned over and the keel and skeg put in place as in Fig. 8. When these pieces are made to fit they are fastened from the inside with 1½-in. and 2-in. screws. Before fastening the skeg

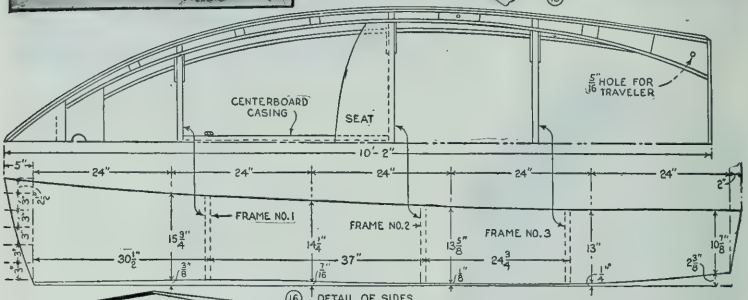


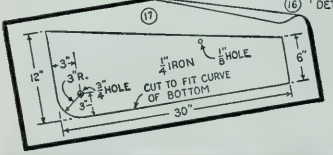
(forward), the cutwater is shaped up to fit in its proper position. When the cutwater fits perfectly, you calk the ends of the sides and fasten the cutwater in place permanently, which is done with 10d galvanized finishing nails spaced 3 in. apart. The cutwater is trimmed with ⅜-in. half-oval brass, which extends from the top edge of the boat to about halfway down the skeg. Finally, the molding, Fig. 9, is fastened in place with 1-in. No. 6 screws spaced 10 in. apart. Use 1½-in. screws through molding at both stem and stern. Bore two ¼-in. holes in the stern knees and put in ¼-in. cotton rope for the traveler. Finally, the rudder is made up as in Fig. 20, and attached with rudder irons to the stern. The lower edges of the rudder are slightly tapered to prevent dragging.

The mast, Fig. 20, is quite simple to make by using one 1¼ x 3-in. x 16-ft. piece of cypress and two pieces of ¾ x 3-in. x 10-ft. Casein glue is used to assemble these parts. With a table saw set at a 45-deg. angle you can rip off the corners up to the 10-ft. mark. This will give you an eight-sided section that can be rounded easily by hand with a small plane. The portion above the 10-ft. mark can be left as it is. At a point 3 in. below the 10-ft. mark a ½-in. hole is bored through the mast to take the spreader, which is a ½-in. brass tube, 30 in. long. A small brass pin through the tube and mast holds the spreader in place. Small holes are drilled in the ends of the tube for the galvanized rigging wire which can be of single strand. It is fastened to the mast 5 ft. above the spreader and 5 ft. below. A ⅝-in. mast track starting 10 in. below the top sheave extends 12 ft. down the mast. Details of the gooseneck are shown in Fig. 20. The boom is tapered to 1¼ in. and a ferrule is slipped over the end, extending 3½ in. back.

When the mast is made up and all the fittings are in place, you install it in the boat. Bore a hole through the mast partner, Fig. 13, and allow the mast to go through until

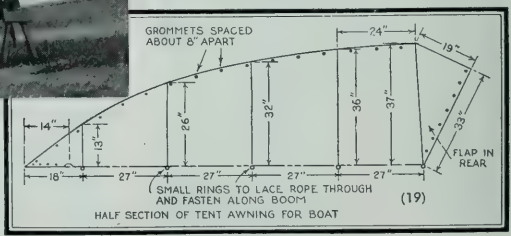


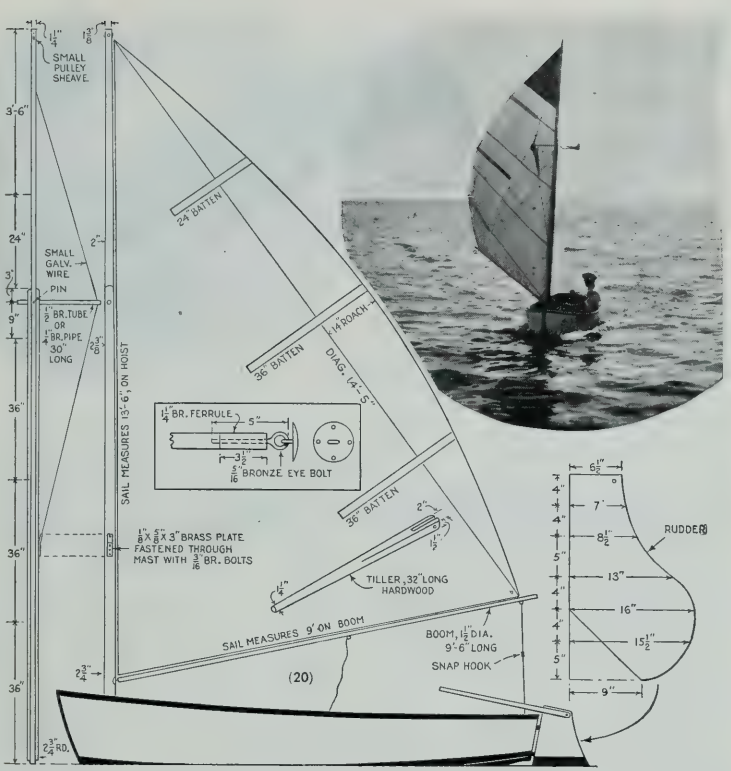




it reaches the step, which is made of 1½-in. material placed in the bow as far up as possible. Do not nail or fasten it in position until you have set the mast plumb. Scribe a line around the squared end of the mast and another outlining the location of the step on the bottom. Then cut a rectangular socket in the step into which the foot of the mast fits snugly. Fasten the step with 1½-in. and 2-in. screws through the bottom and into the skeg. Two upright deck blocks are placed one on each side of the mast on the mast partner. One of these pulleys is used to hoist the sail and the other takes care of the top'n lift. Cleats are attached to the sides of the centercase.

A tent cover, Figs. 18 and 19, is quite simple to make and is a protection to the boat and occupants when making cruises. The edges of the tent are held down by screw eyes spaced 8 in. apart below the boat's molding





MATERIAL LIST

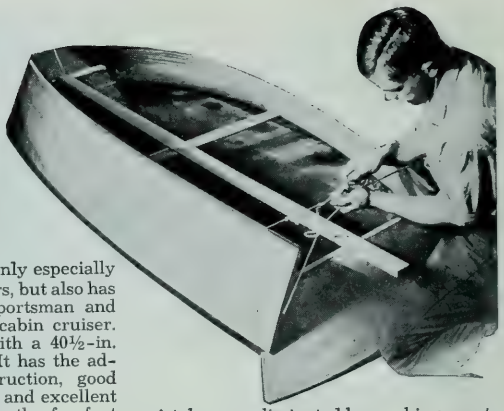
2 pieces ½ x 18 in. x 12 ft. (or equivalent in narrow widths)—side pieces
1 piece ⅝ x 6 in. x 10 ft.—chines
1 piece ¾ x 6 in. x 10 ft.—bottom center plank
4 pieces ½ x 6 in. x 10 ft.—(2 each side)
2 pieces ½ x 8 in. x 8 ft.—(1 each side)
6 pieces ½ x 1¼ in. x 10 ft.—battens
2 pieces ½ x 1½ in. x 10 ft. 6 in.—inner clamps
1 piece ¾ x 14 in. x 6 ft.—sides of centercase
1 piece ¾ x 2 x 26 in.—king posts
1 piece ¼-in. iron—for centerboard
1 piece ¾ x 14 x 30 in.—rudder
1 piece 1¼ x 2½ x 30 in.—tiller
1 piece ¾ x 14 x 38 in.—transom
1 piece 1½ x 3 x 20 in.—mast partner
1 piece ¾ x 10 in. x 4 ft.—seat
1 piece ¾ x 10 in. x 12 ft.—frames and crosspieces
1 piece ½ x 3 in. x 12 ft.—oak molding
1 piece 1½ x 8 in. x 1 ft.—mast step
2 pieces 1½ x 4 in. x 1 ft.—stern knees
1 piece 1½ x 8 in. x 4 ft.—skeg and keel
1 piece 2 x 8 x 24 in.—stem and cutwater
1 piece pine ¾ x 8 in. x 12 ft.—building board
1 piece 1¼ x 3 in. x 16 ft.—mast
2 pieces ¾ x 3 in. x 10 ft.—mast
1 piece 2 x 2 in. x 10 ft.—boom

HARDWARE

2 gross 1½-in. No. 8 flat-head brass screws
½ gross 2-in. No. 8 flat-head brass screws
5 gross 1¼-in. No. 6 flat-head brass screws
1½ lbs. of 1¼-in. copper nails (if battens are used)
½ lb. copper tacks, ⅞-in. (if lap joint is used)
1 sheave for top of mast
2 swivel pulleys for sheet line
2 deck blocks for halyard and top'n lift
1 flat deck block for top'n lift
75 ft. ¼-in. cotton rope for lines and rope traveler
½ pint, C-quality marine glue
¼ lb. casein glue
Brass and brass bolts for guy-wire attachments
3 ft. ⅜-in. half-oval brass for bow trim
25 ft. galv. wire
⅜-in. brass tubing, 30 in. long
2 ft. jack chain for centerboard lift

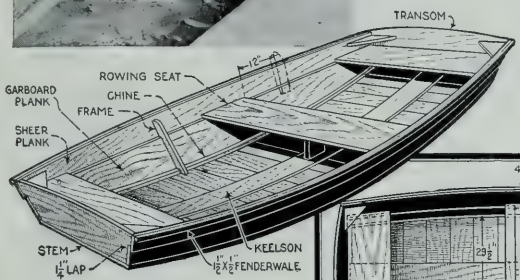
Woods generally used for small-boat construction are: spruce or oak for frame; pine or oak for the stem, and mahogany, cedar or cypress for planking. Knees, mast steps, inwales and other small parts either visible or subject to strain—oak or mahogany.

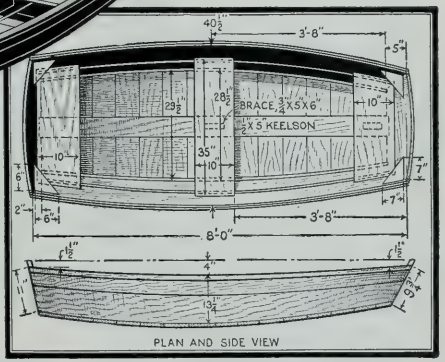
BUILD "SKIP"— *The Pram-Type Dinghy*



HERE'S a boat that's not only especially suitable for young sailors, but also has attractions for the water sportsman and the owner of a sailboat or cabin cruiser. "Skip" is an 8-ft. dinghy with a 40½-in. beam and a 13¼-in. depth. It has the advantages of ease of construction, good light-load carrying capacity, and excellent portability. It is easy to tow, the forefoot having enough "lift" to cause planing when in tow at any speed above four knots. This factor and the fact that Skip's bluff ends make the boat easy to stow away on foredeck or cabin top, recommend the boat as a tender for passenger boats less than 36 ft. in length. Fishermen and hunters will like Skip for its light weight—less than 100 pounds—and the location and elevation of the oarlocks for ease of rowing. The simple design is easy and inexpensive to build.

All wooden parts except the oarlocks, which are white oak, are No. 2 white pine or cedar. The stem, transom and corner braces are cut out of a 1⅛ x 14-in. x 6-ft. board. Sides, keelson and fenderwales are cut from five pieces of ½ x 10-in. x 10-ft. material. The bottom, seat braces and frames are made from two 10-ft. and two 12-ft. lengths of ¾ x 5-in. planks. The seats come from one ¾ x 10-in. x 8-ft. piece, and the chines are two pieces ¾ x 1¾ in. x 8 ft. Construction is much simplified and costly mistakes are eliminated by working exactly to plan. You will need a clear floor space at least 8 ft. wide and 12 ft. long. In this space chalk to full scale all the lines shown in the plan view except those of the seats and braces. Lay out and cut the stem and transom, keeping the saw perpendicular to the material. It is better to cut the bevel with a plane or drawknife afterward. To determine the correct bevel, place the stem and transom on their respective chalk lines, extend the side lines onto them and add 1/16 in. more at the outside. The extra 1/16 in. is for caulking. Fasten the bottoms of stem and transom temporarily to a spacer, making their outside surfaces 7 ft. 5 in. apart, then incline them until the distance between tops is 8 ft. Do this with the parts inverted over the chalked outline, giving a 5-in. displacement to the stem and 2 in. to the transom. Another spacer tacked to the tops will hold the ends in correct position while the planking is applied. A third spacer, 2 ft. 10 in. long, is placed 3 ft. 8 in.





from the bottom of the stem and parallel to it to spread the garboard planks. Make a loop of sash cord around the forward ends of the two garboard planks and draw them in place against the stem. Then, simultaneously, draw the opposite ends until they fit against the transom. The cross spacer should strike at the edge of the planks. Fasten the planks to the stem and transom with 1¼-in. No. 6 flat-head brass screws, which are not to be countersunk. Turn the form right side up and bend and fasten the sheer planks in the same manner. These should overlap the garboards 1¼ in. The rowing seat, nailed to the top edge of the garboards, will be an additional spacer.

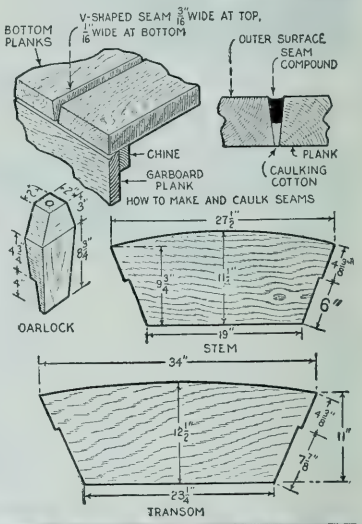
Garboard and sheer planks may be fastened together with screws, clinched nails, or copper rivets. Of these, the rivets are undoubtedly best. The rivets are really small copper nails and washers, and may be obtained at most hardware stores. Drill a small lead hole, then drive the nail from the outside, place a washer over it on the inside, cut it off about 1/16 in. from the washer, and rivet it over with a special tool or a ball-peen hammer, while a helper holds a heavy hammer against the head. You will be able to draw the two planks together very tightly by careful riveting. Space the rivets 3 in. apart and ⅝ in. from the plank edge. The sheer planks are to be 6 in. wide at a point 4 ft. 1 in. from the top of the stem. Bend a thin strip from stem to transom through this point and mark the line. Saw off the excess material above this line, leaving about ¼ in. for planing. Measure the garboard planks 7¼ in. wide at a point 3 ft. 8 in. from the bottom of the stem. From this point bend a strip to the bottom edge of the transom and mark a line. Without the strip, continue this line forward in a smooth curve to the bottom of the stem. Saw away the excess material, as before, leaving about ¼ in. for planing. Save the strips which have been removed to be used later for fenderwales. If the planks are not of the same stiffness, it may be that at this stage the structure will not be true to its lines. However, it may be squared easily by stretching a cord tightly between the centers of the stem and transom. A square held against either should fit exactly against the cord. If it does not, run a rope loop diagonally around stem and transom and tighten until the cord lines up with the square. At this stage fit in the corner braces and the fore and aft seats so that further operations will not pull the hull out of shape. All of these are fastened with 1½-in. No. 8 flat-head brass screws. Always drill lead holes for screws.

The chines should be soaked in water overnight or saturated with scalding water before bending in place. Determine the correct length by measuring with a thin, pliable strip, and cut the chines so that they will fit snugly against both stem and transom. Insert them from the top of the

boat and exercise care to avoid breaking while drawing them in place with carpenter's clamps. Fasten them from the outside with 1¼-in. No. 6 flat-head brass screws spaced about 8 in. apart. Lay a straight plank across the bottom of the boat and plane the chine and garboard until it lies flat on them. Plane a 1/16-in. outward bevel to the garboard to form a caulking seam. Before applying the bottom planks plane a 1/16-in. bevel in each edge. Nail the planks on before sawing and saw at an angle in line with the sides of the boat. Use three 2-in. copper nails for one end of each plank, and smooth up the sawed edges with a plane.

The addition of the keelson completes the bottom. Fasten it with 1½-in. copper nails, five to a plank, clinched outside. From the leftover side planking make two fenderwales 1½ in. wide. Rivet them to the top edges of the sheer planks, plane down to a smooth surface, and bevel all edges. Make two frames to fit, one on each side, about midway between the rowing and forward seats. Use the 1⅛-in. material and fasten with brass screws from the outside.

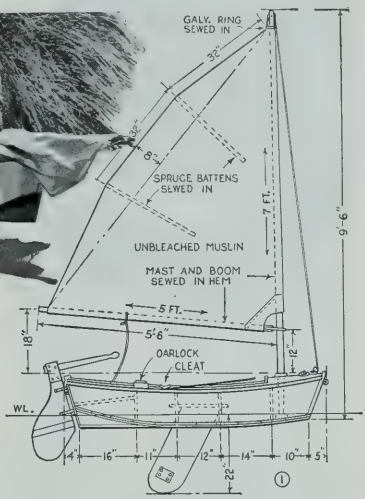
The oarlocks are elevated above the gunwales so that the oarsman will have ample room for his hands when lifting the blades from the water for the return stroke. Make them from 2 x 4-in. white oak to the dimensions shown, and fasten with 1½-in. No. 8 flat-head brass screws from the outside. Finishing the seams is one of the most vital parts of boatbuilding. Leave sufficient spacing between the planks, and caulk with regular caulking cotton, not wicking, until the seam is one third filled. Put the cotton in by hand with a putty knife. Under no circumstances use a hammer. The cotton must remain soft enough to permit the planks to swell without buckling. Fill the remainder of the seam with a good grade of boat-seam compound. About 1 lb. will be sufficient for the entire boat. Then apply three coats of spar varnish or paint.



MATERIAL LIST

- 1 piece 1⅛ in. x 14 in. x 6 ft. white pine—stem, transom and corner braces
- 5 pieces ½ in. x 10 in. x 10 ft. cedar or white pine—sides, keelson and fenderwales
- 2 pieces ¾ in. x 5 in. x 10 ft. and
- 2 pieces ¾ in. x 5 in. x 12 ft. white pine—seat braces, bottom, frames
- 1 piece ¾ in. x 10 in. x 8 ft. white pine—seats
- 1 piece ¾ in. x 4 in. x 8 ft. white pine—chines
- 1 piece 2 in. x 4 in. x 24 in. white oak—oarlocks
- Miscellaneous—Brass screws, copper nails, caulking compound, spar varnish, paint

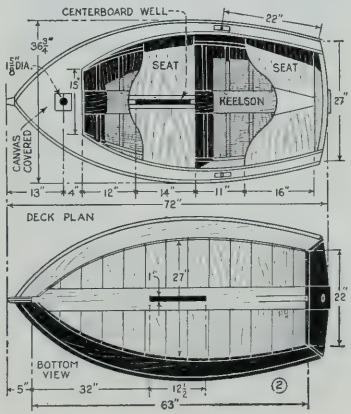
"Tiny"--6-Ft. "Training Ship"

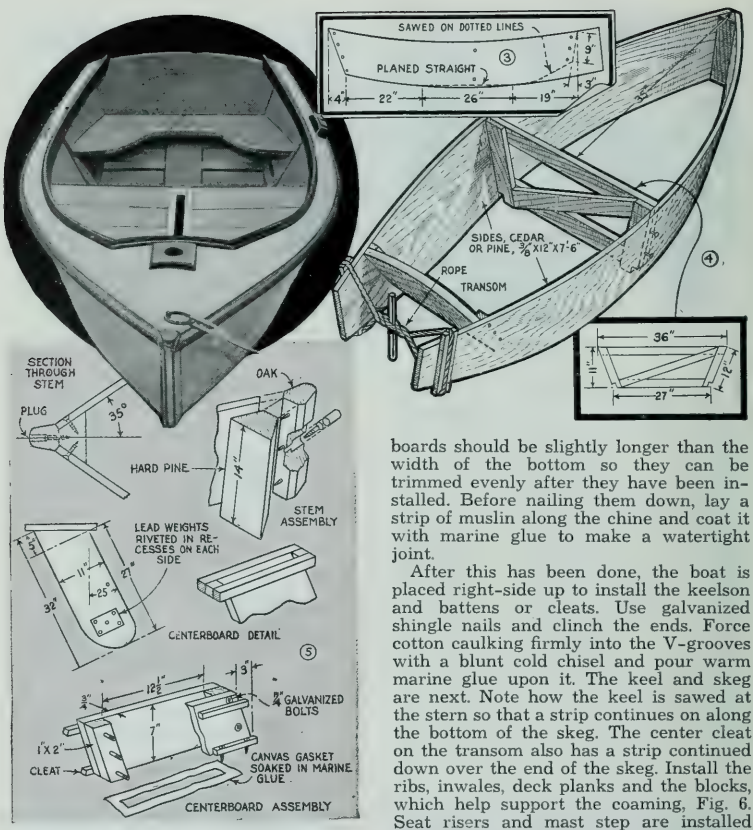


THE MAST was made from a 1½-in. curtain pole. The boom once was a squeegee handle, the sail, a piece of unbleached muslin. That's the kind of material that produced the original "Tiny," a 6-ft. boat that is an excellent sailer despite the fact that it can be hauled to the water on a coaster wagon. With mast and rudder removed, one adult can carry Tiny. Designed and built by Stephen T. Crosby, of Balboa Island, Calif., for his children to learn the art of sailing, it accommodates two passengers, and has all the necessary equipment of a full-size sailboat. General dimensions are given in Fig. 1. From this you will note that the boom is located high above the cockpit to give the skipper full vision, and also to prevent the boom from dragging in the water when coming about. The deck plan in Fig. 2 shows the exceptionally broad beam, lessening the possibility of capsizing.

To build the boat, first make the stem, Fig. 5. You will need only the hard-pine block at first, the oak nosepiece being screwed on later. Next, make the form shown in the lower detail of Fig. 4, around which the cedar sideboards are bent. Then comes the transom, or stern piece, Fig. 6. This is a single piece of ¾-in. mahogany or oak with hardwood cleats on the ends. To shape the sideboards, which should be about a foot longer than needed, wrap them in burlap sacks, one at a time, and pour several teakettlefuls of boiling water over them. After the water has had a chance to soak in, and while the boards are still warm, assemble them as shown in Fig. 4. At the ends nail temporary cleats, notched on the ends, and draw the boards together with a rope. Set in the transom and draw the sideboards up to it by twisting the rope with a stick. Then screw the boards to the cleats on the transom, using flat-head brass screws.

The completed job will appear as in Fig. 4, after which the sideboards should be cut as indicated by the dotted lines in Fig. 3. A curved cross member to support the deck, as in Fig. 6, should be put in temporarily 15 in. from the top of the stem, to keep the sides spread at the bow. A form can be made for this purpose if you wish, and be removed later. Details



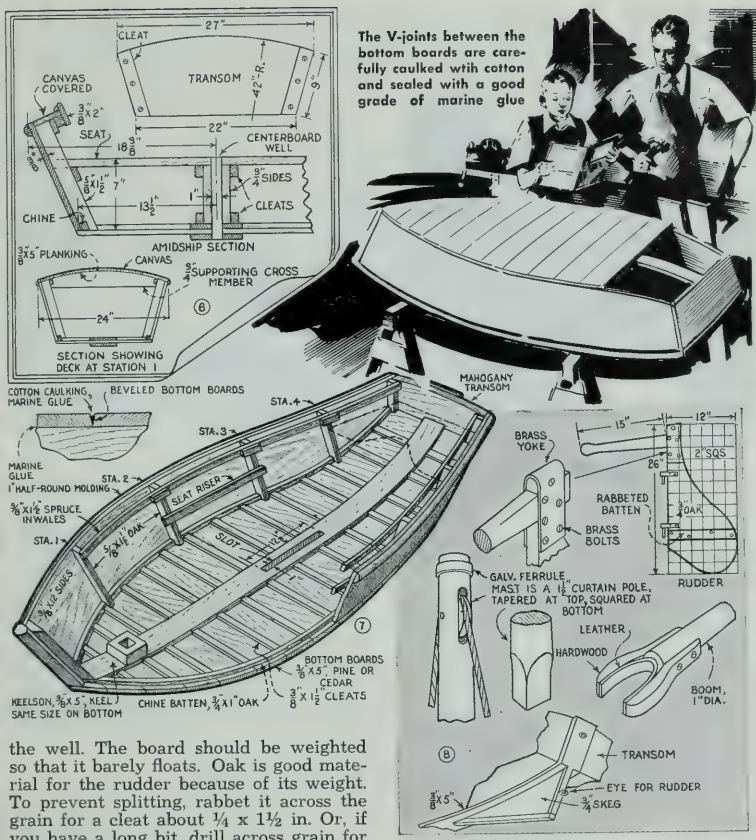


of the construction are given in Fig. 7. While the forms are still in place, the chine battens should be put on. These are of ¾ x 1-in. oak. The stern ends should be steamed or soaked for bending approximately to the curve of the sideboards. The battens are fastened in place with flat-head brass screws spaced 1¼ in. apart. Then the edges of the chines and sideboards are planed off flush to get a good bearing for the bottom boards.

Now turn the boat upside down and put on the ⅜ x 5-in. bottom boards—tongue-and-groove stock. The tongues and grooves are removed by planing and the edges of the boards are beveled slightly so that when butted together a narrow V-joint is formed, which is later filled with cotton caulking and marine glue. The boards should be slightly longer than the width of the bottom so they can be trimmed evenly after they have been installed. Before nailing them down, lay a strip of muslin along the chine and coat it with marine glue to make a watertight joint.

After this has been done, the boat is placed right-side up to install the keelson and battens or cleats. Use galvanized shingle nails and clinch the ends. Force cotton caulking firmly into the V-grooves with a blunt cold chisel and pour warm marine glue upon it. The keel and skeg are next. Note how the keel is sawed at the stern so that a strip continues on along the bottom of the skeg. The center cleat on the transom also has a strip continued down over the end of the skeg. Install the ribs, inwales, deck planks and the blocks, which help support the coaming, Fig. 6. Seat risers and mast step are installed also, and a slot is cut for the centerboard. Location of this is given in Fig. 2.

The deck is laid and is covered with canvas, which is tacked along the gunwale and coaming. Molding covers the tacked edges. The centerboard well is made as in Figs. 5 and 6, with marine glue in the joints and hardwood cleats at the top and bottom. A canvas gasket should be cut and soaked in marine glue for the joint on the keelson, and the inside of the well should be given three coats of paint before assembly. The amidships seat is built around the well as shown in the deck plan. Make the centerboard, or more accurately, the "daggerboard," of a single ¾ x 11-in. board, 32 in. long, and cut the top at an angle as shown. Cleats across the top prevent it from slipping down through



the well. The board should be weighted so that it barely floats. Oak is good material for the rudder because of its weight. To prevent splitting, rabbet it across the grain for a cleat about ¼ x 1½ in. Or, if you have a long bit, drill across grain for two brass rods about ¼ in. in diameter. Attach the tiller with a brass yoke, Fig. 8.

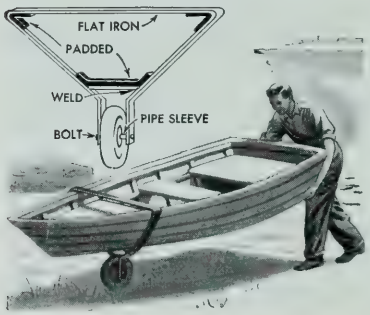
A hardwood curtain pole makes a good mast, and it should be at least 1½ in. in diameter, squared at the bottom for the mast step and slightly tapered at the top. A pulley is set in a slot at the top for raising the sail, and a ferrule prevents splitting. A hardwood squeegee handle, such as window washers use, makes a good boom and should be 5 ft. 6 in. long, exclusive of the yoke. This is of hardwood, lined with leather. Use small brads to fasten the leather on, and drive the heads in well. Unbleached muslin is satisfactory for the sail, which is cut as indicated in Fig. 1. Note that no rings are used, the mast and boom sliding inside wide hems. The sail should be reinforced with canvas gussets at the corners and a galvanized or brass ring sewed into the peak. Spruce battens, ⅛ x 1 x 24 in., are sewed into the sail at the points indicated.

With pulley, cleat, ring bolt and oarlocks installed, the boat is ready for painting. Use copper bottom paint on the bottom and two coats of white on the sides. The last coat may be an easy-brushing mixture of white lead and turpentine which will dry "chalky" and wash away slowly as the boat is used, thus keeping the hull cleaner and more attractive. All mahogany and oak parts should be finished with two coats of spar varnish. The centerboard and rudder are painted a bright red. A coat of green or gray is suitable for the inside.

HANDY WAYS TO MOVE SMALL BOATS

Trailer Hauls Different Boats By Using Special End Gates

Anyone having two boats of different types can utilize one small trailer to haul them by simply making two sets of interchangeable end gates. In this way, it takes but a minute to make the trailer suitable for either boat. The top edge of each end gate is cut to the contour of the boat bottom it is to carry and padded at the points where the bottom of the boat will rest on it. The padding can be pieces of old tires, if available, or you can use several thicknesses of burlap, canvas, or other sturdy cloth.



Handy Cart to Transport Canoe

Small enough to be carried in your canoe when taken apart, this light cart simplifies the problem of transporting a large canoe to and from the water. It consists of two wooden wheels mounted on a pipe axle which is flattened and drilled in the center for attaching screws. As shown, the support is cut to the same contour as the canoe bottom and it is also drilled to accommodate a lawnmower-type handle and locking bolt. Note that the canoe is prevented from slipping by a strap buckled around the handle.

Barrow Hauls Boat to Beach

For moving a boat a short distance to and from a beach, one sportsman attaches rings to the gunwales of the boat to slip over the handles of a garden wheelbarrow. With this arrangement, the inverted boat can be lifted at the stern end and wheeled easily.

Wheeled Dolly for Boats

One man can handle small boats easily with the help of this dolly. It is made of flat iron formed to slip over the bow of the boat. Two legs extend downward to act as a fork for the wheel which is, preferably, one that has a large rubber tire. A bolt serves as an axle and spacing sleeves are used on both sides of the wheel to keep it centered. The corners of the dolly are padded to prevent scratching the finish on the sides of the boat.

PART 9

Build Your Boat *Right!*

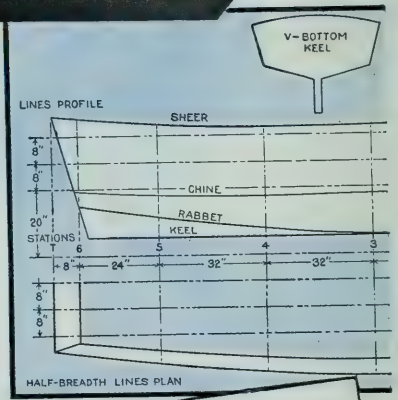
BUILD YOUR

Editor's Note: Information given in this section of BUILD A BOAT is intended only as general introductory information for the amateur in building small boats. Dimensions and details are merely to illustrate the proportions, shapes, positions and locations of the parts and are not sufficient to build any one of the boats in other parts of the book

SUCCESS in building a boat depends on two things, knowing beforehand exactly what type boat you want to build and then getting started right on the construction. Once you have the job accurately laid out the rest is easy.

Laying out plans: When you go over the plans of your boat you will find drawings and figures similar to those shown in Figs. 2, 4 and 5. This includes the lines, profile, half-breadth lines plan and body plan, and table of offsets. From these it is possible to lay out the plans accurately to full size. The first step is to paste together sheets of wrapping paper to make a single sheet large enough to draw the details full-size as in Fig. 6.

When laying off the hull lines first strike the centerline and on this locate the intersections of lines for the various stations, A, 1, 2, 3, 4, 5 and 6 as shown in Fig. 4 and also on your blueprints. These lines should be exactly at right angles to the centerline. Next, consult the table, Fig. 2, "Half-Breadths From Centerline," and you will note that the dimension of the sheer and centerline at station A is given as 0-8-7, which means 0 ft. 8 in. and ⅞ in. Mark that point, then proceed with station 1, which distance from sheer to centerline is 1-6-2, or 1 ft. 6 in. and ⅜ or ¼ in. Continue with all other stations in like manner. When the points showing where the sheer crosses the transverse or station lines are located, bend a 1 x 1-in. pine batten along these points and strike a



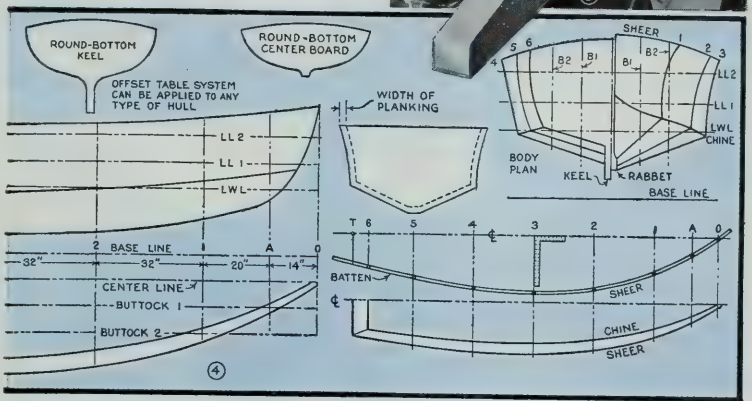
② TABLE OF OFFSETS

DIMENSIONS ARE IN FEET, INCHES AND EIGHTHS OF INCHES AND ARE TO OUTSIDE OF PLANKING

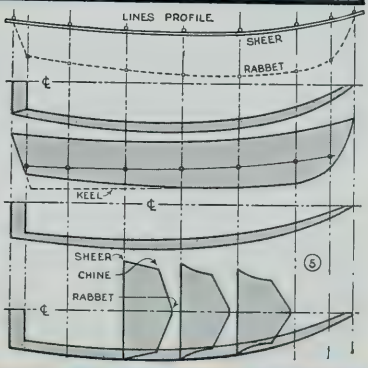
HEIGHTS ABOVE BASELINE								
STATION	O	A	1	2	3	4	5	6
SHEER	3.11.0	3.9.5	3.7.1	3.5.0	3.3.5	3.3.4	3.4.0	3.6.0
CHINE		2.0.7	1.10.5	1.8.0	1.6.2	1.6.0	1.6.3	1.8.0
B 1			1.5.4	0.13.7	0.11.4	1.0.1	1.2.5	1.5.0
B 2				1.5.4	1.2.3	1.2.7	1.5.3	1.7.1
RABBET		1.4.0	0.11.4	0.8.7	0.8.1	0.9.7	1.0.1	1.3.0
KEEL					0.7.6	0.7.0	0.6.1	
HALF BREADTHS FROM CENTER LINE								
SHEER		0.8.7	1.6.2	2.4.0	2.7.0	2.6.0	2.2.4	1.10.7
LL 1			1.4.1	2.1.6	2.5.0	2.5.6	2.1.5	1.11.0
LL 2			1.2.4	1.11.7	2.3.3	2.4.2	2.0.5	1.9.1
CHINE			0.9.7	1.8.1	2.2.6	2.1.1	1.10.1	1.6.7
CWL		0.5.2	1.1.7	1.10.6	2.2.4	2.1.6	1.10.2	1.6.7

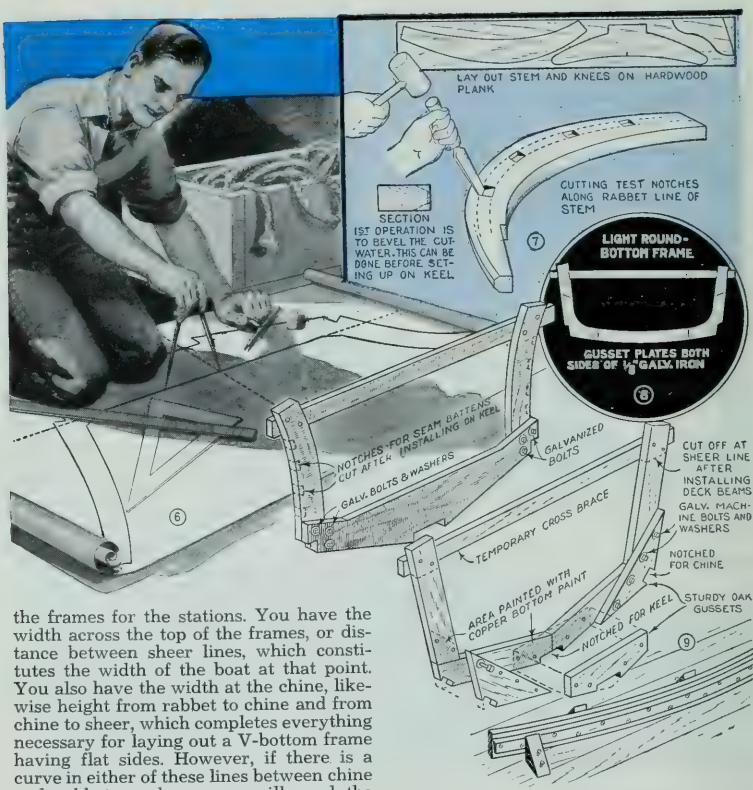
BOAT RIGHT!

line. This will give you the actual sheer line of the completed boat. Use the natural curve of the batten in your work. The chine curve comes next and, to avoid confusion, it is a good idea to use a red pencil or chalk for this. The chine is laid out in the same manner as the sheer line. See the lower-right details in Fig. 4. You will note that in the half-breadth lines plan, Fig. 4, are shown two horizontal lines designated as Buttock 1 and Buttock 2. These are only necessary in round-bottom boats, that is, where the section between keel and chine is curved. Likewise the horizontal lines marked LWL (load water line), LL1 and LL2 are required only where the sides are curved, or have a bulge between sheer line and chine.



To lay out the lines profile you must have a base line, and if your floor space is of limited area, you can use the centerline already drawn as a base line. Vertical lines are drawn at right angles to the base line, and the sheer line laid out by consulting the table of offsets, under "Heights Above Base Line." For instance, location for station O on the sheer line is given as 3 ft. 11 in., for station A, 3 ft. 9⅝ in. When all the locations are marked on the vertical lines, a batten is bent around the curve to touch all the points and the sheer line is marked. In like manner proceed with the rabbet line, the chine and the keel lines, using the same color crayon. Now you can lay out

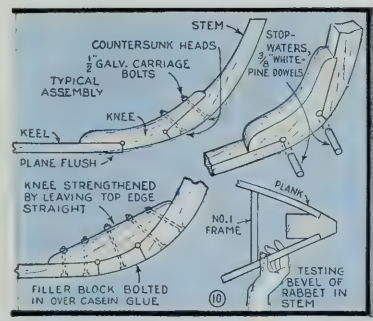




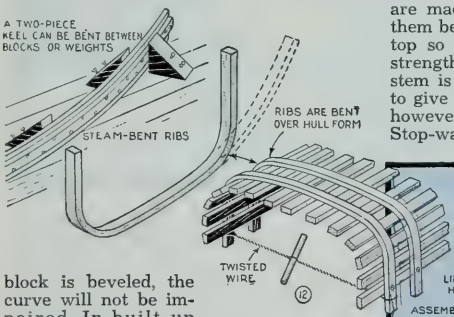
the frames for the stations. You have the width across the top of the frames, or distance between sheer lines, which constitutes the width of the boat at that point. You also have the width at the chine, likewise height from rabbet to chine and from chine to sheer, which completes everything necessary for laying out a V-bottom frame having flat sides. However, if there is a curve in either of these lines between chine and rabbet or sheer, you will need the body plan as in the top-right detail, Fig. 4, and the lines Buttock 1, Buttock 2 and, depending on the boat, LWL, LL1 and LL2. The dimensions given on the offset table, Fig. 2, are to the outside of the planking. Therefore, in making station frames, be sure to allow for the planking width.

Building the frames: If other wood is not specified, make the frames of white oak. Usually they are made with a lap joint at the chine, bolted with galvanized bolts on the larger hulls. Side members are always longer than the completed job, with a temporary cross member to prevent their being forced in when putting on the planking, Figs. 8 and 9. This cross member is later removed. Notches for seam battens are best cut after the frame is installed on the keel, for better alignment. Notches for keel and chine are cut before fastening the frame to the keel. An exceptionally sturdy frame without excessive weight is made by bolting on oak gussets at the chine and keel. The contacting surface is first painted over with copper bottom paint. Machine, instead of carriage, bolts are used with washers on each side. For a light sailboat or dinghy, water-resistant plywood, brass or galvanized gussets can be used. Steam-bent ribs, Fig. 12, are used in many designs, and are prepared for bending by steaming or boiling in a tank or large iron pipe, Fig. 14, for about an hour. They are then bent to shape over an inverted form on which the boat is to be built, the ends clamped or screwed to the form, or drawn down by twisting wire, as shown.

Building the keel: Keels usually are of white oak and can be made in one or two pieces. The one-piece job requires roughing out the rabbet on a circular saw and finishing with a plane. If there is a pro-

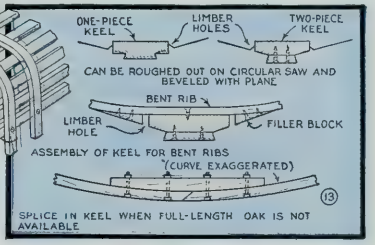


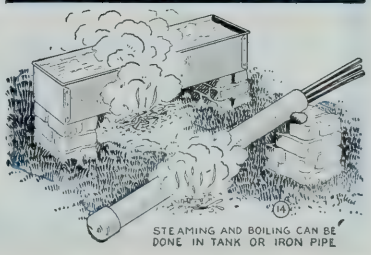
nounced curve and it is necessary to assemble the two-piece keel before putting on frames, the two members can be bent between blocks nailed to the floor and screwed together in that position, Fig. 12. Copper bottom paint should be used on the contacting surfaces. If pieces the full length of the boat are not available, the keel can be spliced, as indicated in Fig. 13. This makes a very strong joint and, if the upper



block is beveled, the curve will not be impaired. In built-up frames, the keel is set in a notch, but with the steam-bent frame this is not practical, so filler blocks are used instead, as shown in Figs. 13, 15 and 16.

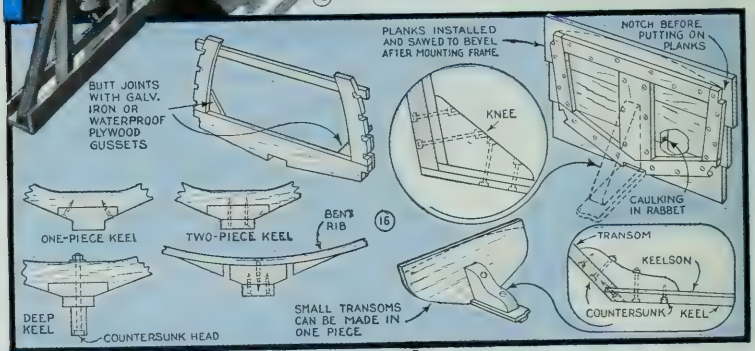
Shaping stem and knee: Oak may be used for stem and knee, Figs, 1, 3, 7 and 10. As a rabbet or V-groove must be cut for the ends of the planking along its curved length, the beginner may wish to make his stem in two pieces, bolted together. In this manner he can form the groove with drawshave and plane, whereas in a one-piece stem the work must be done with a chisel. In the latter case the rabbet must be finished while the stem is installed on the keel permanently. Preliminary test notches may be cut on the workbench. When set up, these notches can be tested with a stick, or "fid," held against the first frame as in the lower-right detail, Fig. 10. When the test notches, Fig. 7, are the proper depth, chisel out the waste between them to the same depth. Knees, Figs. 10 and 11, are made in two or three forms, one of them being left with a straight edge at the top so as to take advantage of the full strength of the wood. Cutting a curve in a stem is partly for appearance and partly to give more room forward. Shorter bolts, however, can be used in a cut-away knee. Stop-water plugs are essential. These are

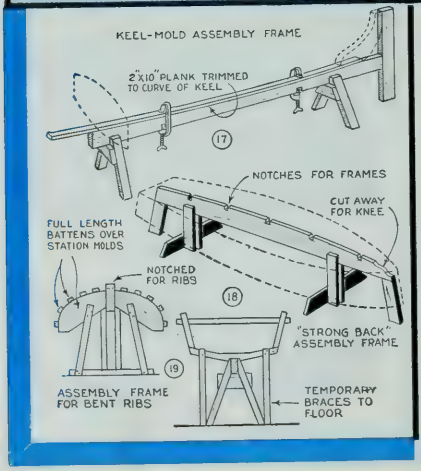




simply soft white-pine dowels, about ⅜ in. in diameter, driven in to a tight fit. Moisture causes them to swell and form a watertight joint, Fig. 10.

Building the transom: The design of most boats permits transom frames to be set up on the keel the same as station frames, and the planking put on later. In this case the transom frames differ from station-frame construction only in that there are butt instead of lap joints, with gussets on the forward side as in the upper-right detail, Fig. 16. Small transoms can be made in one piece without cleats or battens, but always require a knee. Getting the proper bevel on a transom is a job done best after the transom is on the keel. Roughing cuts are done with a handsaw and finished with a plane. Where two or more planks are required for the transom, a neater caulking job is accomplished by setting candle wicking in a rabbet with marine glue, rather than in the V-joint which would be visible. Bolt heads in transoms should be countersunk enough to be covered with a wooden plug.



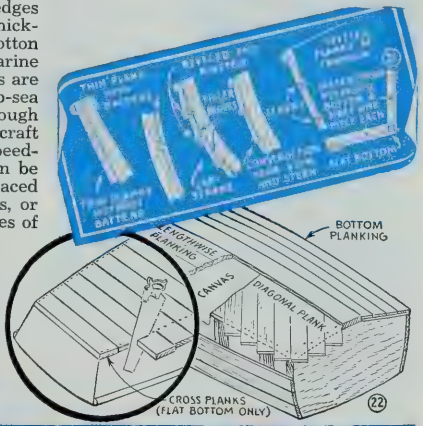


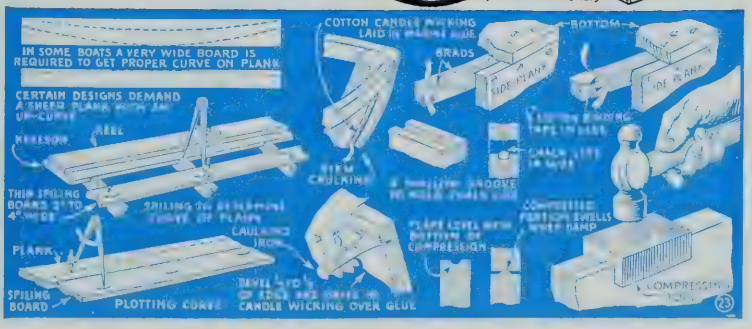
Fastening frames to keel: Galvanized or bronze hardware should be used throughout in all boats, especially in parts below the water line. Various methods of fastening frames to the keel are given in the lower-left details, Fig. 16. In all cases screw or bolt heads outside the hull must be countersunk.

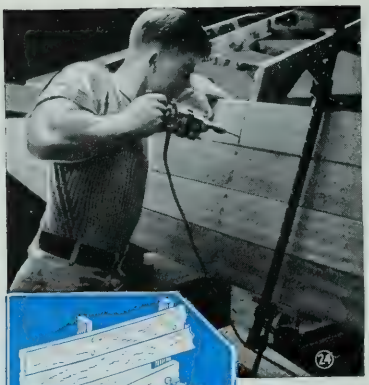
Assembly frames: Building a boat on a specially constructed frame makes the work much simpler. An easy one to build is a simple keel-mold with an upright at one end to support the stem, Fig. 17. The keel-mold is simply a plank with the up-

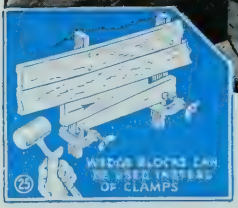
per edge trimmed to the curve of the keel. In this type of frame the boat is built upright. By building the boat upside down the planking problem is much easier. Another common method is the strongback assembly frame, Fig. 18. Hulls with bent ribs are easily built over a form as shown in Fig. 19. For hulls over 20 ft. long, and of considerable weight, a frame can be built of a series of 2 x 4-in. uprights cut to the proper length and angle to conform to the rabbet line, Fig. 15. The keel or keelson is easily bent to this line by a weight after which it can be secured with four or five screws driven into the uprights. When a deep keel or shaft log is to be installed, two or three of the uprights are simply knocked out to make room.

Planking: Having erected the frames on the keel in their relative positions, planking is the next step. There are several arrangements of planking, illustrated in Fig. 21. Thick planks, ¾ in. and up, can be installed on the frames without battens, because there is enough surface on the edges to permit beveling from ½ to ⅓ the thickness forming a V-groove into which cotton candle wicking can be driven over marine glue or white lead. The thicker planks are advised for heavy-duty boats, deep-sea cruisers, and others designed for rough going rather than speed. For lighter craft such as outboard runabouts and speedboats, planks from ⅜ in. to ½ in. can be used provided battens, Fig. 20, are placed behind the joints. Overlapping planks, or lapstrake, are suitable for several types of hulls. The lap is secured with copper rivets, marine glue or white lead being applied first to the contacting surfaces. Toward the stem and stern the bevel of the planks becomes wider, until at stem and transom the planks present a smooth surface. This arrangement of planks can be applied to round or V-bottom hulls. For small craft such as skiffs under 12 ft., ¼-in. or ⅜-in. waterproof plywood makes construction very simple and the job needs caulking only at chines, stem and transom. When





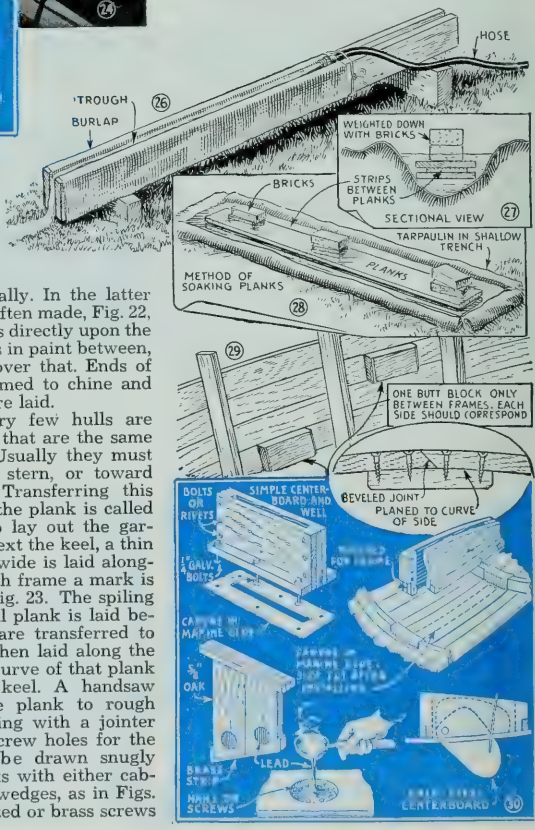




should be used, the heads countersunk and covered with putty after the first coat of paint. Remember that the planks are first partly beveled along the edge.

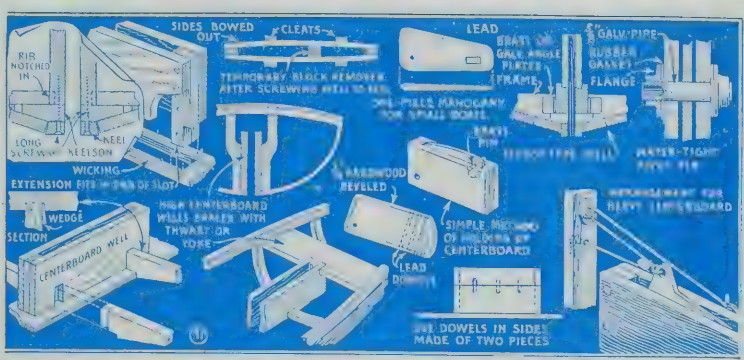
Caulking: Several methods of caulking are shown in Fig. 23. When the edge of the plank has no curve it can be grooved to a depth equal to about half the diameter of a chalk line. A strip of the latter is laid in on marine glue, and the next plank is brought up tightly against it, compressing the chalk line. A favorite method of waterproofing at the chines is to fasten cotton candle wicking diagonally with brads hammered over, and laid in marine glue. Binding tape serves the same purpose.

Compressing the center portion of the plank edge with a special tool also gives satisfactory results, as shown in one of the



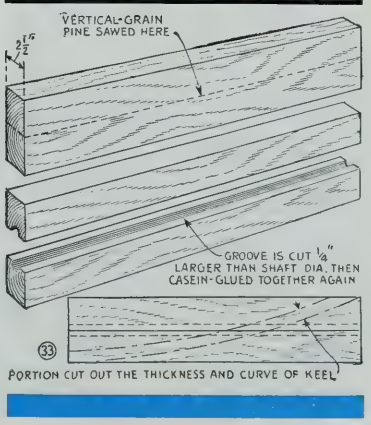
planking the frame, usually the sheer planks are installed first, alternating one plank starboard, then one on the port side. Bottom planks can be laid longitudinally, crosswise, or diagonally. In the latter case a double bottom is often made, Fig. 22, with thin diagonal planks directly upon the frames, a sheet of canvas in paint between, and lengthwise planks over that. Ends of the planks are not trimmed to chine and transom lines until all are laid.

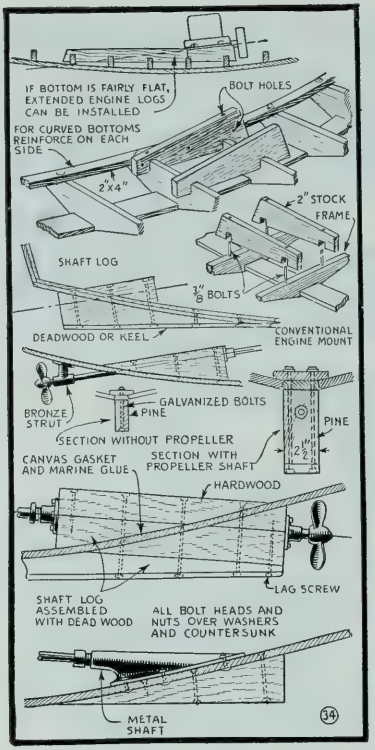
"Spiling" planks: Very few hulls are designed to take planks that are the same width and full length. Usually they must be tapered toward the stern, or toward both stem and stern. Transferring this curve from the boat to the plank is called spiling. For instance, to lay out the garboard strake, or plank next the keel, a thin spiling board 4 or 5 in. wide is laid alongside the keel, and at each frame a mark is made with a compass, Fig. 23. The spiling board is removed, a hull plank is laid beside it and the marks are transferred to the plank. A batten is then laid along the marks to give the true curve of that plank as it fits against the keel. A handsaw is best for cutting the plank to rough shape. Allow for finishing with a jointer plane. Before drilling screw holes for the planks, they should be drawn snugly against preceding planks with either cabinetmaker's clamps, or wedges, as in Figs. 24 and 25. Only galvanized or brass screws



details, Fig. 23. The wood is planed down to the level of the depression, the planks placed closely together, and subsequent dampness swells the compressed portion quickly, making a watertight joint without caulking. Then there's the old reliable method of tamping in candle wicking with a caulking tool over marine glue. For the stem rabbet a cable of five or six strands of wicking is laid in marine glue, and the same procedure followed on the edges of the transom. If the planks must take an unusual twist, and no facilities are available for steaming or boiling, a good soaking in water will limber them up. If only one end is to be bent, wrap in burlap as in Fig. 26, and let a stream from the hose trickle down it throughout the night. For full-length soaking, dig a narrow trench, Figs. 27 and 28, lay in an old tarpaulin, fill with water and weight the planks with rocks or bricks. Place strips of wood between them so that water will reach all sides. Fig. 29 shows the method of using butt blocks where the planks are not long enough to reach the full length of the boat.

Centerboards and wells: Special care must be given to the construction of the centerboard well because it is here that leaking invariably begins after a rough sail. A simple, satisfactory well is shown in Fig. 31. Cleats along the sides are bolted through the keelson, with a canvas gasket in marine glue laid between. The centerboard for this is ½-in. oak weighted with lead, anchored in circular openings with nails or screws. A brass strap along the bottom serves to reinforce the board and forestall warping. Whenever a wooden centerboard is used, allow at least ¼ in. extra width in the inside well opening to take care of swelling and warping. Another method of caulking the well is shown in Fig. 31, which also details methods of framing the well in the hull. The well is wedged



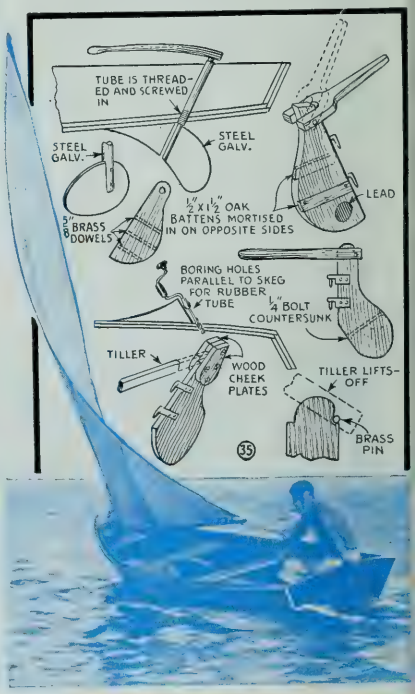


with a temporary block until it is screwed in place, which counteracts the tendency of the damp inside walls to warp inward. The inner, vertical cleat has an extension which sets down into the end of the slot in the keel, making a watertight joint. See the upper-left detail. The hull frames are notched into the well sides, or a dovetailed joint can be made which prevents the ends of the frames pulling out under stress. Steel centerboards, properly galvanized, are superior to the wooden ones since they do not warp and at the same time serve as ballast. For small craft, a one-piece mahogany or oak centerboard, weighted with lead, is permissible. Weight is added in some wooden boards by drilling holes and inserting, or pouring in, lead "dowels." To hold the centerboard up, especially if steel, a brass pin can be used, or a block and pulley, with line and cleat. When a fairly high well is required, and two boards are necessary on a side, the joint should be doweled to keep the edges of the boards in alignment.

Engine logs: It is important that the timbers supporting the engine be substantial and very securely anchored. The usual arrangement is illustrated in Figs. 32 and 34, the timbers being cut on an angle to correspond to the angle of the propeller shaft. The timbers are notched and bolted to the hull frames, but unless the bolts are put in during construction it will be necessary to use lag screws driven in from the top. To make the bed exceptionally rigid where there is too much up-curve fore and aft for long timbers, install 2 x 4s on each side to cover several frames. Of course only galvanized, bronze or brass hardware should be used. Long timbers are always desirable.

Installing shaft log and deadwood: The deadwood or keel extension is assembled as in the lower details of Fig. 34, being used on the sides of the propeller shaft. Bolt heads must be countersunk on the bottom.

Making and installing a shaft log is quite easy if done as in Figs. 33 and 34. Select a piece of vertical-grain pine at least 2½ in. thick, and saw through the middle as indi-



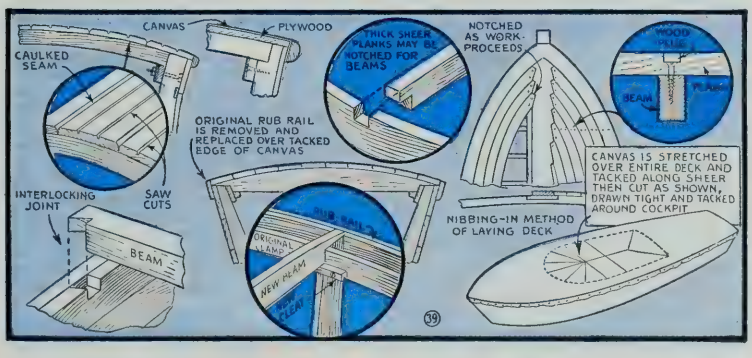
cated by the dotted lines. Then cut a groove in each half so that when put together the hole will be ¼ in. larger in diameter than the propeller shaft, to allow for clearance. Assemble the two halves with casein waterproof glue, and then saw away on a diagonal curve corresponding to the thickness of the keel at the point of installation. The completed job is shown in Fig. 34. In this detail the shaft log is assembled with the deadwood. The latter can also serve as the lower exterior half of the shaft log. A hardwood strip is bolted along the bottom of the deadwood. Metal shaft logs, purchased from marine hardware dealers, make the work very simple.

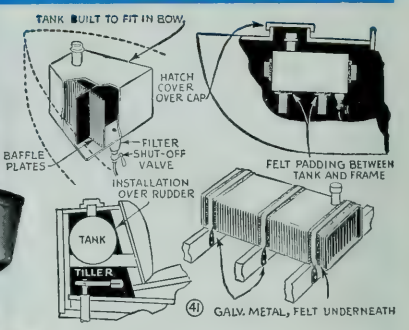
Rudders: Except for racing, the simple rudder board, hinged to the transom and fitted with a tiller, is adequate. The inboard rudder post makes the neatest assembly, and requires a brass tube running through the deck and into the keel, as in Fig. 35. The rudder post should be galvanized, and the rudder can be installed in a slot and riveted. Wooden rudders, if very wide, should be reinforced to prevent splitting under stress. Tillers in most cases are made to lift off. Edges of wooden rudders should be beveled.

Laying the deck: Decks may be covered with waterproof plywood, as in light sailboats where beams are placed close together, or planked in cruisers, as shown in the details in Fig. 39. If plywood is used it always should be covered with canvas. The latter is not so slippery in wet going as a smooth finish would be. The crown of the deck is usually 1 in. per foot of beam width. In other words, if the beam is 4 ft. the deck should curve upward 4 in. above the sheer line. In installing the beams, it is advantageous to bolt or screw the ends to the tops of the frames or ribs. If the latter are too far apart, place beams between, supported by short cleats, Fig. 37. Where the sheer plank

TESTING DECK BEAMS WITH A STRAIGHTEDGE (38)

is thick and wide enough, it is safe to notch for the beams, as in Fig. 39. However your beams are installed, they must be tested for warp with a straightedge, Fig. 38, as one or

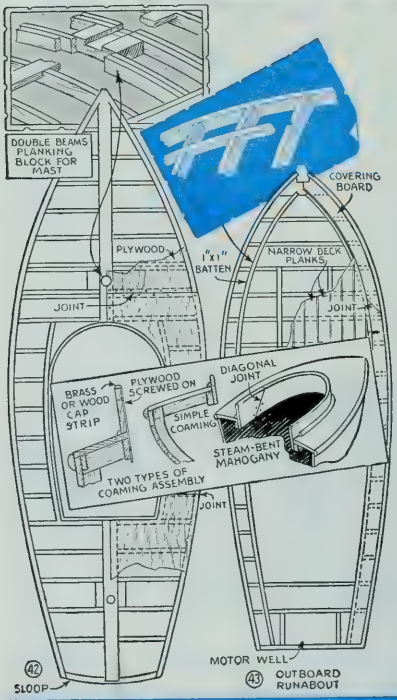


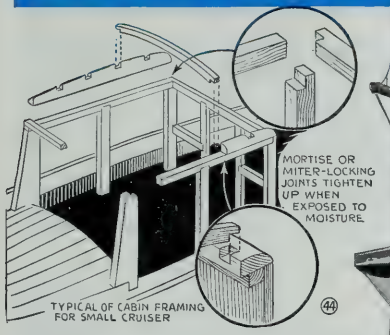


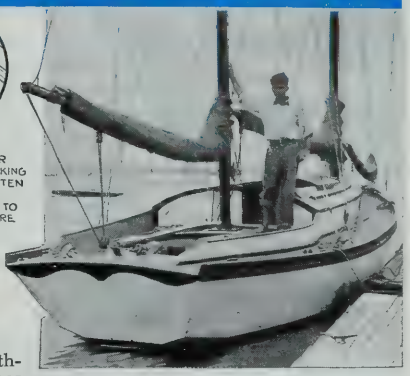
two might have warped out of line after installation. In case of an open boat, such as a dory, which you wish to deck over, all that is necessary is to remove the rub rails, and build as shown in the lower-center detail, Fig. 39. Lay canvas over the planking, copper-tack down along the sheer and cover with the rub rail. Arrangements of beams for a sailboat differ somewhat from those of a cruiser, Figs. 42 and 43. Here are shown plywood decking for the sloop and planking on the cruiser. The plywood is cut, in this case, in six panels of three pairs, joined at the centerline and transversely on two of the beams. These joints will be covered with canvas. Casein glue is applied to the tops of the beams before the plywood is screwed down.

In decking over the cruiser, covering boards are used around the gunwales. It is necessary to set in a batten to which the ends of the fore-and-aft straight planks are screwed. This batten is set in notches to lie flush with the beams. Owing to the curve near the bow it is necessary to make the covering board in two pieces, with a diagonal joint.

Another arrangement of the deck planking, known as the "nibbing in" method, is shown in the top-right detail, Fig. 39. Each plank end must be fitted as you go along, the notches being cut at the time of fitting, since each strikes the king plank at a slightly different angle. In laying canvas over a deck, professional boatbuilders have their own methods. One is shown in the lower-right detail in Fig. 39. The canvas is pulled as tightly as possible over the whole deck and tacked at the gunwales. Then the builder treads back and forth







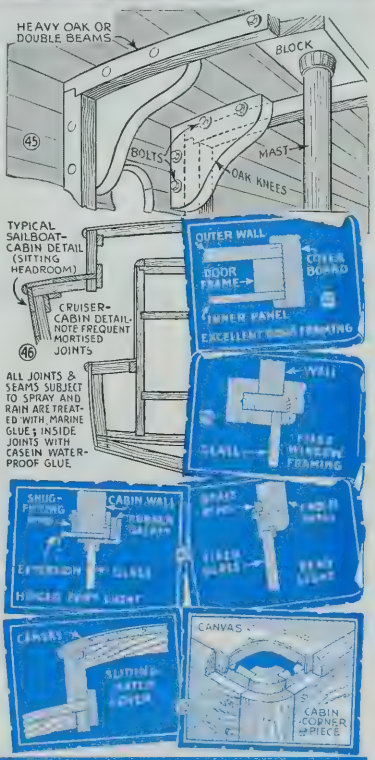
on the portion over the cockpit. This method takes out the last bit of slack and shapes the canvas to the deck. Many builders lay the canvas in wet paint. Others soak it in water first and wring out thoroughly, then apply casein waterproof glue to the wood deck. They draw the damp canvas tightly over this and proceed with tacking.

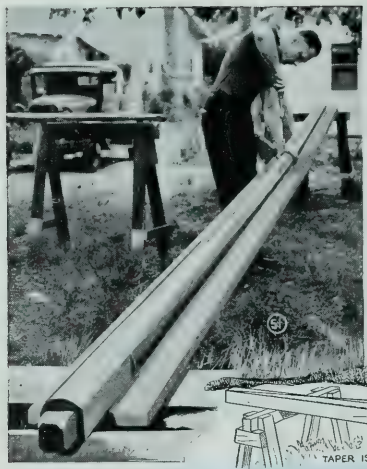
Fuel and water tanks: Installation of fuel or water tanks in certain hulls will have to be made before the deck is laid. Fuel tanks should be anchored securely to the framing, and should be equipped with baffle plates, Fig. 41. Felt or leather strips should be placed between the metal tank and wood supports. Care must be taken to have all connections protected from injury in case cargo or equipment slides about in a heavy sea. See that nothing movable can come in contact with the gas line. Freshwater tanks should be protected from the sun, and of a material that will not contaminate the water.

Coamings: A trim cockpit coaming adds as much to the smartness of a boat as any other one feature. Mahogany is a favorite material and when steamed will bend readily. Usually there is an inner frame of the same shape to which it is screwed, and the curved front portion joined at an angle. See the details in Figs. 42 and 43.

Cabin framing: A cabin is really a high coaming with a roof and port lights. Typical designs for small boats are shown in Figs. 36, 40 and 44. Special attention always must be given to the joints of the cabin framing, Figs. 44 to 50 inclusive.

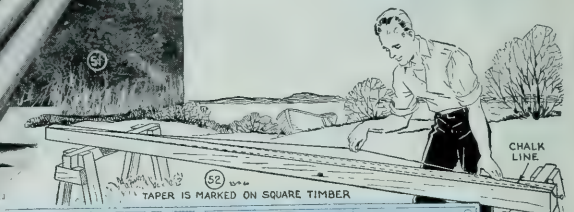
A typical example of good cabin framing is illustrated in Fig. 44. Joints exposed to rain and spray should be sealed with marine glue before assembly, and unexposed joints with casein waterproof glue. Install

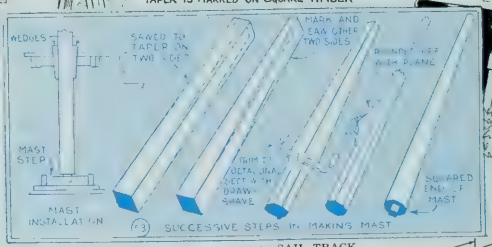




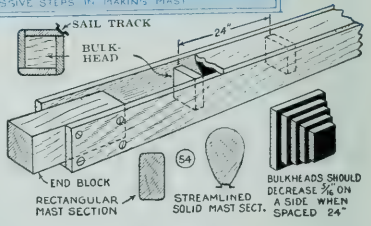
squared to a taper, the rest is easy with drawshave and plane, Fig. 53. A square mast is built up as shown in Fig. 54 to give a taper of about 2 in. in 24 ft. This type is exceptionally strong, when assembled with casein glue, finishing nails and screws.

When screwing down a sail track, Fig. 51 shows one thing to avoid. Note the curve in the mast. After the track is screwed in place it is likely to hold the mast to that curve. The photo has been purposely exaggerated to emphasize this point. See that the mast lies straight before screwing down the sail track. For a light sailing





a panel of hard-pressed board on the roof before the planking is laid, as this reinforces the structure horizontally, and makes a better appearance inside. Galvanized or brass screws should be used instead of nails, the heads countersunk and covered with putty. Several joints are detailed in Figs. 47 to 50 inclusive. A covering strip over a door, Fig. 47, keeps out moisture and presents a smooth appearance; Fig. 48 shows how to build watertight window frames, while the right-hand details, in Fig. 50, illustrate a substantial corner piece for the cabin. Extra-heavy beams with knees should be installed flanking the mast, as in Fig. 45, and a sliding hatch cover can be made as in Fig. 50, the left-hand detail. Port and dead lights should be absolutely watertight, Fig. 49.

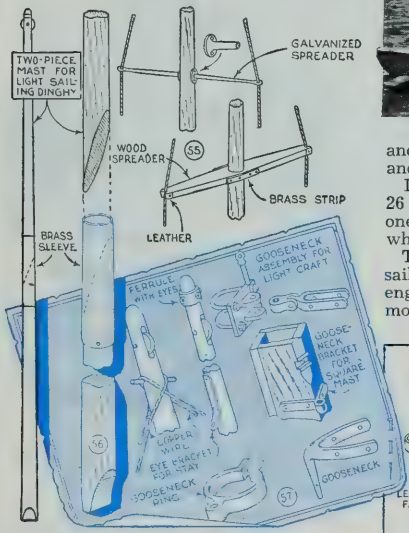


Mast, boom and fittings: Selecting the stock is the important thing in making a mast. Spruce or vertical-grained pine is satisfactory. Either is purchased in the square piece, and of course should be free from any defects. If newly surfaced, paint it with linseed oil to prevent checking if you do not intend to trim it at once. The first step in shaping is to mark tapers on all four sides, easily done with a chalk line as in Fig. 52. Begin the taper at the point where the mast meets the deck. After being dinghy, a jointed mast is permissible, made as shown in Fig. 56. This can be lifted out and stowed in a small space. Several types of mast fittings are illustrated in Fig. 57. Most of these are standard, and can be purchased ready-made. Spreaders for extra-tall masts are illustrated in Fig. 55. Fig. 58 shows booms and the fitting of a turn button at the lower end of the sail track.

Puttying and painting: Putty should not be applied to raw wood because the latter absorbs the oil, causing the putty to dry out and crumble. Apply linseed oil to the

caulked seams with a seam brush, as well as in the countersinks for the screw heads, and putty afterward. Copper bottom paint is applied directly to the raw wood below the waterline. Do not give a priming coat of oil, because it prevents the copper paint from adhering. Two or three coats are adequate. Above the water line prime with linseed oil with just enough white lead to give it body. When dry, coat with marine paint. For planked decks, a spar varnish is generally used. The mahogany transom, coaming and rub rails are treated likewise.

Registration: All privately owned inboard motorboats, and outboard boats more than 16 ft. long, must carry United States Coast Guard registration numbers on both bows. A number will be assigned the boat after application has been made on Form CG-1512, copies of which may be obtained from the nearest Coast Guard District Office. For a new boat, a statement

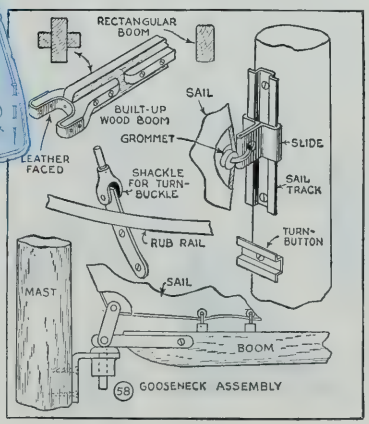


of specifications and bills for lumber, engines, hardware, etc., must accompany the application. The boat owner will receive a "certificate of award of number."

Inboard boats less than 16 ft. long must carry the following equipment: combination light, showing red to port and green to starboard and visible at least one mile; one white light aft, visible at least two miles; one life preserver for each person aboard; one approved fire extinguisher; one flame arrestor on each carburetor of the engine, and two or more cowl ventilators for engine and fuel tanks.

Inboards and outboards between 16 and 26 ft. must carry, in addition to the above, one hand, mouth or power-operated horn or whistle audible for at least one half mile.

There are no federal requirements for sailboats, as such. However, an auxiliary engine of any kind puts the sailboat in the motorboat class.



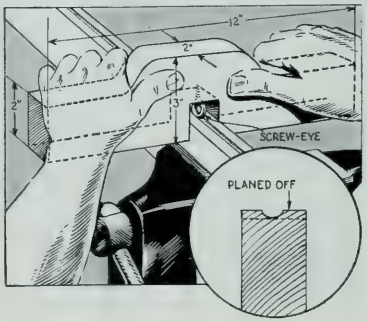
BOATBUILDER'S SHORT CUTS

Boat Seams Are Calked Easily

If you have had difficulty in finding a tool for pressing oakum into the seams of a boat when calking it, try a single-blade food-chopping knife of the type shown above. You will find the knife ideal for the purpose, and the rocking motion that can be imparted to the curved blade enables you to press oakum firmly into the joint.

Allow For Swelling of Seams

Owners of wooden boats should not pack calking too tightly in the seams. When the wood swells, the screws may be pulled loose and cause the boat to leak. If a narrow space is left between the calking and the wood to allow for swelling when the boat is put in the water, it will remain dry throughout the season.



Gauge Marks Planking

Assembled from scrap pieces of hardwood, the simple marking gauge shown below is especially handy in boatbuilding where the ends of bottom planks are cut after they have been screwed in place. The gauge is made by screwing three blocks of wood together, after which a pencil holder is provided by driving two staples into the edge of the upper block. Note that the bottom of the gauge is a little wider than the top to allow for the thickness of the pencil. In use, it is held against the side of the boat and advanced along the bottom planks, being careful to hold it vertically.

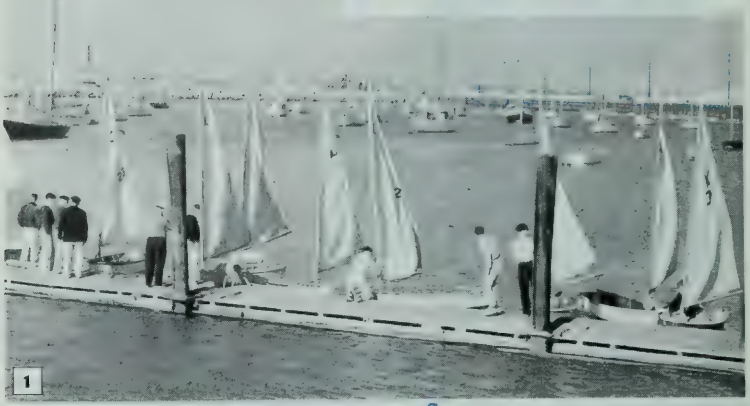
◀ Home-Made Compression Tool Makes Tight Boat Seams

By compressing the wood along the edges of boat planking before screwing it in place, you can get exceptionally tight seams. When the compressed portions of the planks get wet, they swell to make a tight seam. A good tool for compressing the planks is made from a piece of hardwood cut to the shape shown at left and fitted with a screw eye to serve as the compressor. After a groove has been compressed in the plank, the edge is planed down flush with the bottom of the groove. The line of compression should be centered on the plank edge to be most effective.

PART 10

Seamanship
and Servicing Your Boat

YACHTING



1

ONE GOOD WAY to budget individual costs to a minimum and still enjoy all the thrills of sailing is to form a yacht club. Any group of friends with a common interest in sailing can pool talents, equipment and cash, and thereby gain all the advantages of group action on the purchase of additional gear, boats, tools, shore property for a clubhouse site and other incidental items. A clubhouse, grounds and a pier come high on the list of requirements. With careful planning, a clubhouse and a suitable pier can be built by the club members, thus confining the cash outlay to that required for good materials. Every clubhouse should have private rooms for changing from ship to shore clothes, a locker for each member so that he has space for storage of sails, clothing and other small gear, and a fairly complete set of tools for the common use of all members for repair and maintenance. No clubhouse really "belongs" until it is fitted out with a flagpole rigged complete with yardarm so that the national ensign and club pennants can be flown in correct order on all occasions. Landscaping, telephone, an oar rack and other minor details of the layout usually are decided by a vote of the club members. A slanting dock constructed at the water's edge is handy as small sailing boats can be hauled up on it between runs or for minor repairs. A small pier adds to the completeness of the layout, provides for loading and discharge of passengers and serves as a temporary mooring for the boats when readying sail, Fig. 1. In some cases, the more rough-and-ready sailors will prefer the beaching dolly, Fig. 3. Using discarded auto parts, this can be put together to suit average individual requirements at a very nominal cost. Such a dolly is a must where it is necessary to transport small boats some distance to a yard for storage or for extensive repair. In repair and maintenance of boats, and construction of additional equipment, special skills of the members should be administered so that each individual contributes an equal share. With careful planning, clubs can build their own boats at greatly reduced costs by arranging a change-work schedule which includes all members.

Sailing dinghies, or "dinks" as they are often called, are the smallest and simplest of the common sailboats. Having only one sail, they are easy to handle because there is no complicated rigging unless, of course, you add a spinnaker like the more daring sailors in Fig. 2. And if members are holding costs to a minimum, then the club will own mostly little boats of the Snipe class with perhaps an occasional Lightning or

ON A BUDGET

Comet, which are larger, or in other words, a lot more boat. But the pleasure of sailing your own boat is not determined by the size of the craft or the amount of money you, as an individual member of your club, spend on the sport. With skillful handling, the tiny little boats of the Snipe class are flashy performers and once you get the feel of sails in a fair wind you'll understand why seasoned yachtsmen regard this particular sport so highly.

If you are a beginner, you'll need to take lengthy counsel with an experienced member of the club before venturing to hoist sail alone, Fig. 5. Take an instructor with you, not only on the first trip, but on several succeeding trips. You must acquire absolute confidence in the boat and in your own ability to handle it. Many beginners have difficulty overcoming the fear of getting away from shore, especially if there is a fairly strong offshore breeze. But a competent sailor will show you how to run out before the wind, then turn, come into the wind and tack back across it to the harbor, Fig. 9. You will be much impressed with the ease with which he handles the latter


2

Below left, a beaching dolly is just the thing for launching small boats without the aid of a dock crane or where they are transported some distance for repairs. Right, approved manner of holding tiller and sheet


3

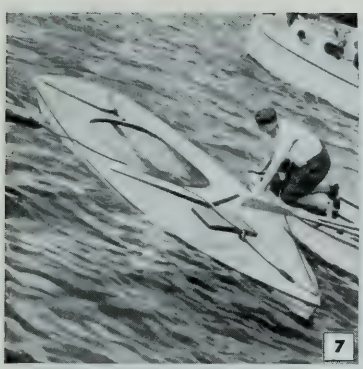

4

If you're a beginner at sailing, do not hoist the sail alone. Have competent sailor teach you the rudiments

If you drive your boat hard, always keep on the weather side and hold the sheet ready for instant trimming of the sail

maneuvers; how, after running on the port tack for an interval (reach), he eases off on the sheets to luff sail and simultaneously puts the rudder hard down to tack ship. The boom will swing to the opposite side to allow the sail to catch the wind from the new quarter, and before you know it your little boat is away on the starboard tack. It's a neat trick just to watch, if it's done by an old hand, but the real thrill comes when you do it yourself for the first time. Once you see demonstrated how quickly and smoothly the craft responds to the rudder and the set of the sail, you get the idea that with fair and steady winds you can go anywhere there is water under your keel, and you can come back just as easily to home harbor.

Your sailor friend also will show you how to turn into the wind and coast your little boat smoothly up to the dock. To do this expertly you have to judge distance and wind strength to a nicety, because a light boat loses way quickly on being turned into the wind. It's a good idea to practice the maneuver often in both light and strong winds. Fig. 4 shows an approved manner of holding the sheet and tiller when sailing a small boat. It's easy and comfortable and you're in a position to slack off instantly on the sheet if the boat heels (tips) too sharply to an unexpected gust. And this brings up one of the first principles in sailing a small boat. Always hold the sheet in your hand. Never snub it, or fasten to a cleat, for even when the weather is fair and the wind light, some unlooked-for emergency may make it necessary to trim sail quickly to release wind pressure. Keep the sheet free. It's a rule in small boats. When sailing, except perhaps when everything is going smoothly as in Fig. 8, it's regular practice to sit on the weather side of the boat, that is, the side from which the wind is coming, Fig. 6, and change from starboard side to port side

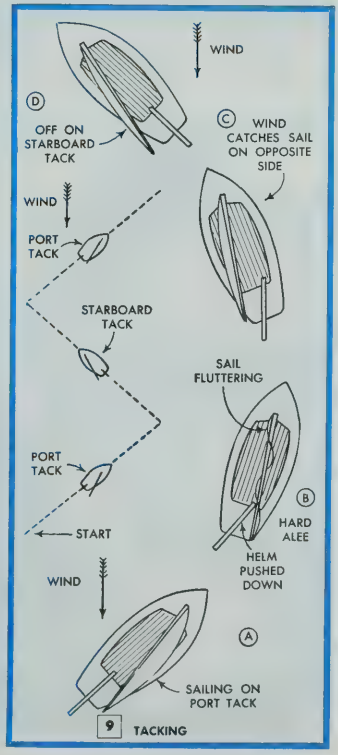


Above left, quick work with tiller and sheet usually will avoid heeling and capsizing, but if you do go over, the boat will not sink unless the hull is badly damaged. Right, all a yachtsman asks for is smooth sailing

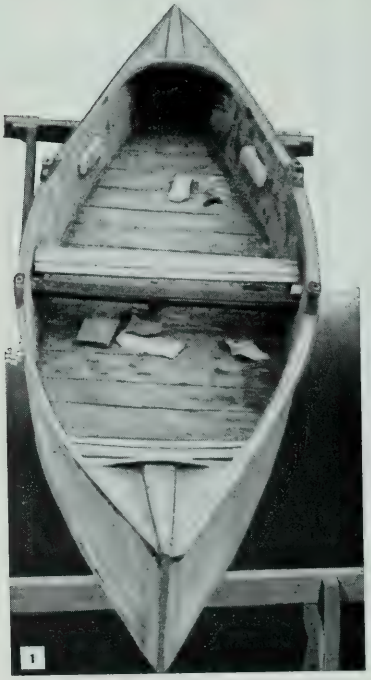
and back again when you're beating to windward on repeated tacks. If the wind turns suddenly gusty or if a squall races down on you and the boat begins to heel alarmingly, ease off on the sheet and the tiller simultaneously. Or, if it looks like an emergency, merely let go of everything. The sail will swing out and the boat will come up into the wind and right herself. If you are quick, you usually can avoid capsizing, even when hit by a severe gust or wind squall. The student sailor need not unduly fear capsizing, for small sailboats do not sink readily when upset, Fig. 7. Unless the hull is damaged by collision or other accident, it will support your weight until a rescue party comes alongside and picks you up.

When working back to windward, that is, tacking, many beginners tend to sail too close to the wind on the port and starboard tacks. This probably is due partly to the amateur's desire to reach home port, but mostly to the natural tendency of small sailing craft to come up into the wind when running the reach between tacks. To get the full drive of the sail and to steady the boat, it's generally considered good practice to hold her off, even where you must shorten the reach between port and starboard tacks. In this, good sailors rely on their judgment and gauge the procedure by the performance of the boat under varying conditions. Many sailing practices apply only loosely to the handling of the very small boats, particularly after one gains experience and comes to know his own boat well.

After you have mastered ordinary sailing techniques under the tutelage of your instructor and have gained confidence in yourself, your boat and your ability to take her out in any reasonably good sailing weather, you're eligible in most unofficial small clubs to wear the snappy blue-and-gold yachting cap and club emblem.



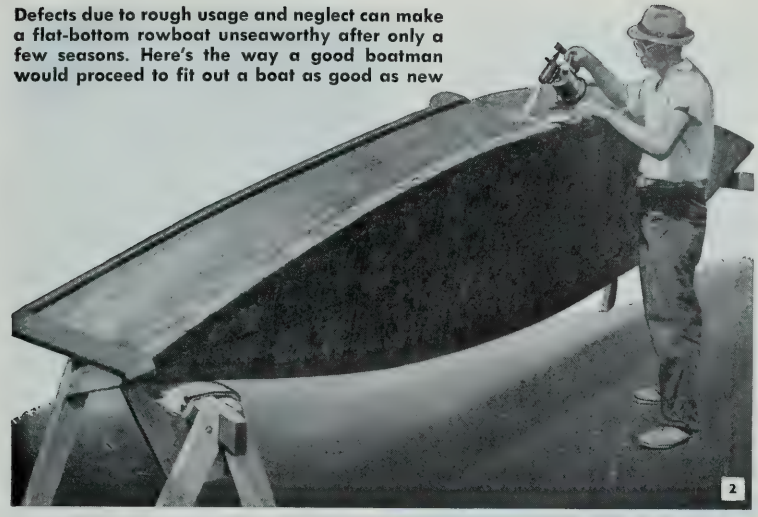
Make Your Rowboat *Shipshape*



BY USING the ordinary "making ready" methods of the good boatman, a worn and leaky flat-bottom boat, or "sharpie" as it is sometimes called, can be made shipshape in a few hours' time. In general, the methods used will apply to any type of boat, flat, round or V-bottom, but just what you do depends primarily on the age and condition of the craft. A boat that is taken from the water and stored during each off season probably will require very little repair from year to year, but work boats used by trappers, hunters and others need frequent and thorough check-ups. Flat-bottom boats that are merely tied up when not in use become waterlogged, leaky and hard to handle. In time, either dry or wet rot or both will weaken the boat so that it is structurally unsafe.

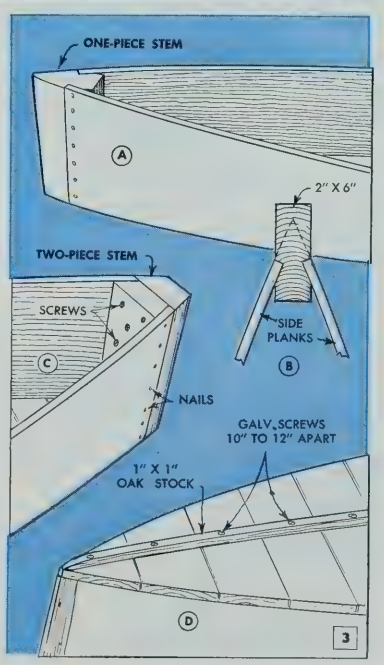
If the condition of the boat indicates only the normal amount of wear and the paint is chalky, but not peeling or scaling to the bare wood at any point, then sandpapering and painting are all that is necessary to recondition it. However, scaling paint, damaged oarlock mounts or decks and the presence of dry rot in the bottom planks or the stem call for complete repair and refinishing. If this must be done, place the boat on sturdy saw horses, as in Fig. 1, and remove the paint either by softening the film with a blowtorch, as in Figs. 2 and 4, or by use of a paint remover. With either method, use a scraper to remove all the loosened paint down to the bare wood. Check the side and bottom planks along the chine for dry rot by forcing

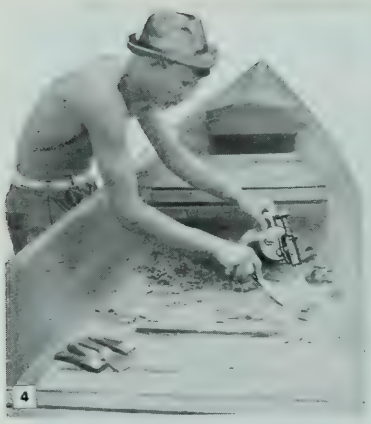
Defects due to rough usage and neglect can make a flat-bottom rowboat unseaworthy after only a few seasons. Here's the way a good boatman would proceed to fit out a boat as good as new



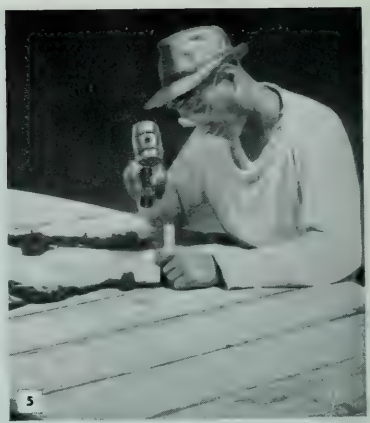
a knife blade into the wood. If any of the planks are soft they should be replaced. Often a new stem will be required because of dry rot or wet rot due to lack of ventilation under the deck. Two common methods of making a stem for a flat-bottom rowboat are shown in Fig. 3, details A, B and C. The one-piece stem, details A and B, made from selected oak, is the best although it is more difficult to make. The ends of the side planks are fitted into rabbets cut into the stem block at the correct angle, detail B. Then the projecting portion of the block is shaped to form a cutwater. This can be straight vertically or at an angle as desired. In the built-up stem, detail C, the rabbet is formed by joining two beveled blocks of different widths. The blocks are joined with heavy galvanized screws and marine glue, although waterproof cabinet glue also can be used. Use galvanized screws or bolts wherever it is necessary to employ metal fasteners. In replacing any parts, select sound, seasoned stock and be sure to duplicate the dimensions of the old part in all details in the new one.

Prepare the wood for the priming coat of paint with a thorough scraping and sanding. Renew the calking in the bottom planks, Fig. 5, and replace the keel, detail D, Fig. 3. If necessary to replace any bottom planks, it is important that the grain run the same on all pieces, detail D, Fig. 6. Repair or replace the decks and oarlock mounts and also the rub rails, if necessary, Fig. 6, details A to D inclusive. Be sure that

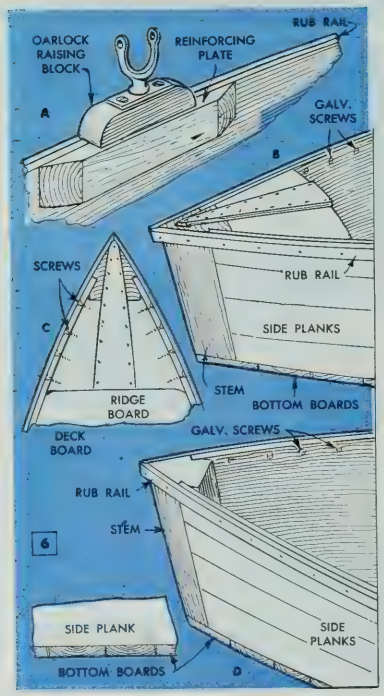




When refinishing, pay special attention to the inside of the boat. Damaged paint should be loosened with a blowtorch and scraped to expose bare wood



Recalking periodically will assure a tight, dry boat and add greatly to the life of bottom planking. Important thing is to calk joints uniformly



the wood is thoroughly dry before applying the first priming coat. In priming a boat, usually it is best to apply two or three thin priming coats with long intervals of drying between. Brush out the priming coats well to assure uniform coverage, and be especially particular to work the primer into all exposed end grain. Use a primer with a white-lead base. After priming, most boat refinishers go over the entire surface and fill all dents, nail holes and slight nicks either with a filler made from white-lead paste or a commercial seam sealer made for boat work. Then the surface is carefully sanded in preparation for the application of the finishing coats of full-bodied paint. The last priming coat must be thoroughly dry before applying the first finishing coat. When painting the bottom, or any part where paint must be brought up to an edge, draw the loaded brush off the edge, not against it. In this way you will avoid drips and sags in the paint film which result from careless application. The first finishing coat should be thinned with a reducer to an easy brushing consistency. The second finishing coat can be slightly heavier, perhaps, but avoid a heavy application. Two finish coats over a three-coat primer should be sufficient to produce a smooth, durable finish. If desired, a copper bottom paint can be applied instead of the lead-and-oil priming coat. The copper-base paint may be applied only to the bottom boards, or can be brought up the sides to the load water line. In this case, the sides are primed and painted with a lead-and-oil paint from the water line to the sheer line.

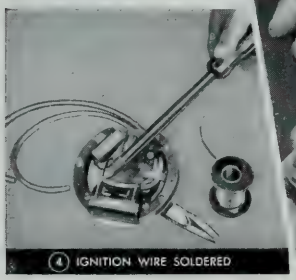
Servicing Your OUTBOARD

HAVE you ever noticed some fisherman fruitlessly cranking his outboard motor with an occasional "spit and sputter" the only reward for his labor? Such hard starting generally can be avoided if you use the recommended gas-and-oil mixture and if the motor is properly serviced from time to time to keep it in tip-top condition.

Ignition: Housed under the flywheel, Fig. 13, the ignition system of a modern outboard motor is surprisingly dependable, but it does require attention. At least once each season the flywheel should be removed and the entire magneto cleaned and adjusted. On many motors the nut that tightens the flywheel also serves as a flywheel puller, Fig. 1. A shoulder on the nut contacts the starting-rope plate, and after the nut is loosened, a turn or two forces the flywheel from the tapered end of the crankshaft. All electrical connections should be checked for tightness. A loose condenser should be tightened, Fig. 2, as this may cause hard starting. Ignition points should be faced true on an oilstone and set to factory specifications. In the absence of such information, adjust the points to open .018 to .020 in., Fig. 3. Lubrication consists of a tiny bit of light oil applied with a toothpick to the pin that supports the movable contact point, and just a touch

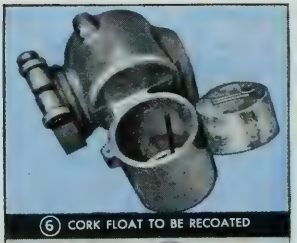
① REMOVING NUT THAT TIGHTENS FLYWHEEL

② TIGHTENING THE CONDENSER

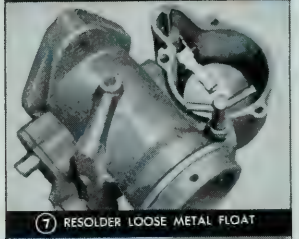


④ IGNITION WIRE SOLDERED

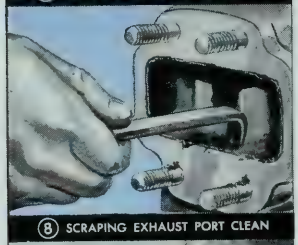
③ SPACING IGNITION POINTS



⑥ CORK FLOAT TO BE RECOATED

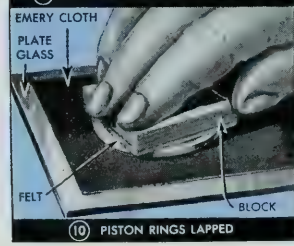


⑦ RESOLDER LOOSE METAL FLOAT



⑧ SCRAPING EXHAUST PORT CLEAN

⑨ CHECK RING-GROOVE CLEARANCE



⑩ PISTON RINGS LAPPED

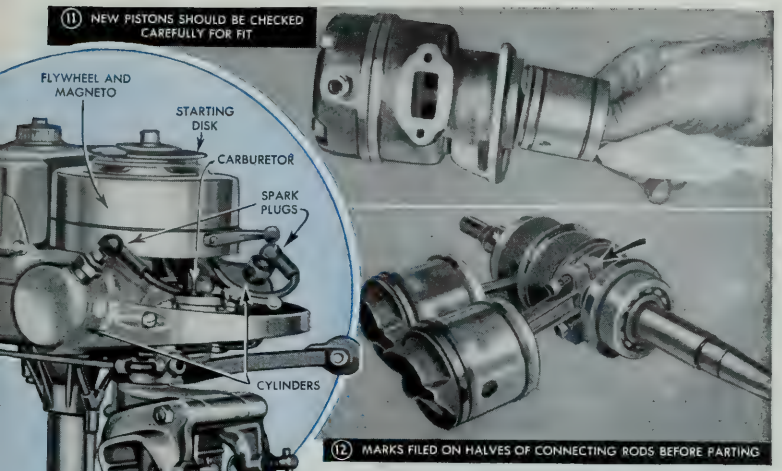
⑤ SHELLACKING GASKET

of hard grease applied to the cam which is an integral part of the crankshaft. If starting has been difficult, it is a good idea to take the flywheel to an authorized outboard-motor service shop and have the magnet recharged.

After several seasons of use, constant flexing of the high-tension wires, as a result of advancing and retarding the spark, may cause insulation cracks which lead to loss of spark. If available, new wires should be installed as in Fig. 4. In soldering electrical connections always use non-corrosive flux—never acid flux! When testing the spark of an outboard magneto it is important that the ignition wires be held not more than ⅜ in. from some metal part of the motor to which the spark may jump. Cranking the magneto with the wires hanging in space invites a breakdown in the insulation of the coil.

Carburetors: Sometimes the shellac coating on cork floats gradually deteriorates, allowing fine particles to loosen and clog the carburetor. Then the float also loses its proper buoyancy and cannot control the gas flow. The permanent cure for this condition is to remove the float and allow it to dry thoroughly. After this, any loose particles should be sanded off and the entire float given two thin coats of shellac, Fig. 6. Also, it is not unusual to find floats disconnected from the arm, with the result that the carburetor shuts off all fuel, and operation becomes impossible. As this type of carburetor has a metal float, the cure is to solder the float back onto the arm, Fig. 7. Any metal float that has a leak should be pierced with a needle opposite the leak, so that all the liquid and fumes can be blown out. Then the hole and original leak should be soldered, using as little solder as possible to avoid reducing the buoyancy of the unit.

Compression: Although everyone realizes the importance of compression in the combustion chambers, the necessity of compression in the crankcase of a two-cycle outboard motor often is overlooked. Without this compression, the fuel charge is not delivered effectively to the cylinders. A simple check for crankcase compression is to remove all the spark plugs and then crank the motor. You should be able to feel very slight compression in the crankcase and to hear a definite "plopping" sound.



(11) NEW PISTONS SHOULD BE CHECKED CAREFULLY FOR FIT

(12) MARKS FILED ON HALVES OF CONNECTING RODS BEFORE PARTING

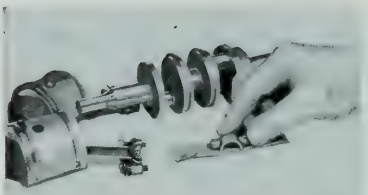
(13) ARRANGEMENT OF PARTS ON TYPICAL OUTBOARD MOTOR

Leaky gaskets, loose bearings or shaft glands in some motors can totally destroy crankcase compression. New gaskets should be installed, or if these are unavailable, sometimes the old ones can be made compression tight by using a high grade gasket cement as in Fig. 5.

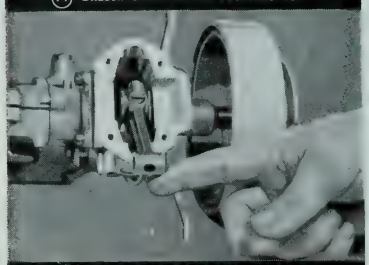
Carbon: One of the most essential services is removing carbon from the exhaust system, Fig. 8. As one cannot build a good hot fire in a furnace that is clogged with ashes, so also is it impossible to get good operation from a motor that is clogged up with carbon. It is not difficult to remove the exhaust manifold and scrape the exhaust ports. Some even go a step further and streamline the passages by polishing the surfaces in the exhaust opening as well as in the intake openings. In streamlining the gas passages be sure that the edge of a gasket does not project into a passage and cause turbulence, thereby restricting the flow. Frequently a hand scraper such as is used for fitting bearings proves useful in scraping the edge of port or piston for perfect alignment. Naturally, care must be taken to see that the motor is not operated with any metal particles left in the cylinder.

Pistons: Contrary to popular opinion, the pistons and rings in an outboard motor do not need to be tight in the sense that they butt closely at the ends or fit very snugly in the grooves. An end gap of .004 to .005 in. for each inch of piston diameter generally will prove satisfactory, and vertical play in the grooves of as much as .004 or .006 in., Fig. 9, will do no harm provided the rings are not warped and the ring grooves are not rough. Lapping piston rings to remove high spots is done on a piece of plate glass on which is held a sheet of fine emery cloth. The ring is pressed uniformly against the cloth by a small block of wood padded with felt as in Fig. 10. The felt assures uniform pressure on the ring and keeps the block from slipping. Working the ring back and forth over the fine emery in a figure-eight pattern will remove any high spots. Obviously this operation should be done only to the amount required to get a true surface.

Prior to removing any part from a motor, it is well to mark the part on an unfinished surface so that there will



⑭ DRESSING CAP ON CONNECTING ROD

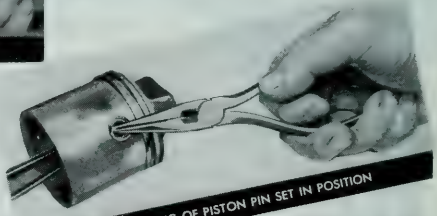


⑮ CONNECTING ROD FALLS FREELY

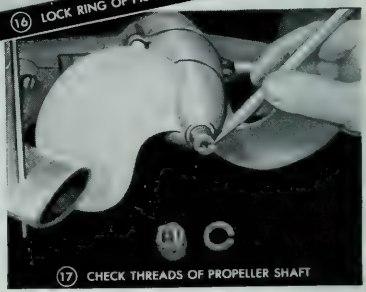
be no question about returning it to its original location. As indicated in Fig. 12, this is especially true when removing connecting-rod bearings which should be marked lightly with a file or sharp center-punch before being taken from the shaft.

Should it be necessary to install new pistons, be sure they have proper clearance, Fig. 11. Since fitting a piston too tight can cause serious trouble, installation of new pistons should be left to outboard mechanics. While in automotive service a "rule-of-thumb" way of checking pistons is to figure on .001 in. of clearance for each inch of piston diameter, the average clearance for outboard work will be more nearly .0015 in. for each inch of piston diameter. Finally, after the rings and pistons have been fitted, the owner who wants peak performance follows the example of outboard racing drivers and laps in the pistons and rings with a creamy paste consisting of a soft abrasive window-cleaning powder and light engine oil. This paste is dripped in through the port while the motor is being cranked with power applied generally by a heavy-duty electric drill or a lathe, continuing to run the motor in this way until all surfaces have a fine finish and there is no drag anywhere. Then, the entire motor is dismantled, after which all traces of the abrasive are washed out thoroughly with gasoline.

Connecting rods: Fitting connecting rods is something that the mechanically inclined owner can do himself, and when there is unusual clatter in a motor it may suggest that the bearings should be tightened. Rod adjustment can be done by facing the bearing halves as seen in Fig. 14. Too tight a fit must be avoided. While no noticeable play should be present in the rod when properly fitted, still there must be absolutely no drag, and the rod must fall freely of its own weight when checked on the tip of the finger as in Fig. 15. One thing that certainly will damage a motor results when the lock ring at the end of the wrist pin works loose. Continued operation after this has developed will be certain to ruin the piston and cylinder. Consequently, when working on any motor, it is most important to see that the ring, Fig. 16, is securely snapped into position. When operating a motor that has an unusual noise it should be checked immediately or it may be damaged beyond repair. If your outboard develops a sing-



⑯ LOCK RING OF PISTON PIN SET IN POSITION



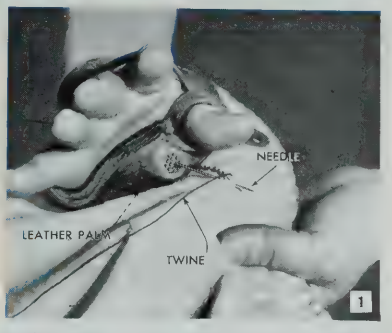
⑰ CHECK THREADS OF PROPELLER SHAFT

ing sound, by all means check the lubricant in the lower housing or you may soon have a set of junk gears.

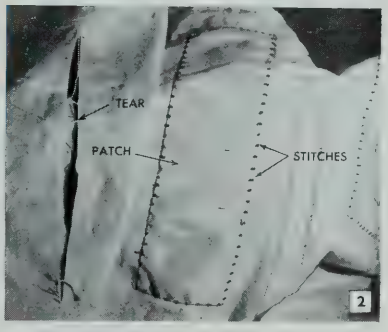
Propeller: And while on the subject of servicing the lower end of the motor, it sometimes happens that forcing the propeller nut on too tightly injures the threads on the propeller shaft, Fig. 17. When this has happened, it may be possible to clean them up a bit by using a three-corner file.

HOW TO MEND TORN SAILS

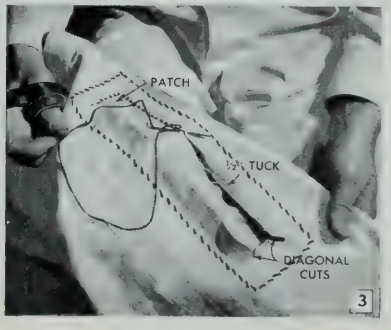
EXPERIENCED sailors avoid the risk of being caught with a torn sail aloft by keeping sailcloth always in good repair. A short tear takes the drive out of a sail and a bad tear, which usually starts with a small rip in the canvas may leave your boat wild a long way from help or the home port. Mending sail will come easy to the amateur yachtsman after he learns the tricks of handling a sailmaker's needle and how and where to use the flat and herringbone stitches employed by the professional sailmaker. Inventory of a sailmaker's "ditty bag" will show that it contains one or more sailmaker's needles, a "palm thimble" or palm, as it is called, a sharp knife, a ball of twine (it is never called thread) and a lump of sailmaker's wax. In the sailmaker's loft, the wax is referred to as "composition." All these items are available from marine-supply dealers at a nominal cost. The palm is made from soft leather and fits in the palm of the right hand as in Fig. 1. An indented metal plate sewed into the leather palm serves as a "thimble" for forcing the heavy needle through the cloth. The procedure pictured in Figs. 1, 2 and 3 shows how to apply a patch to a straight-line tear, using the flat stitch,



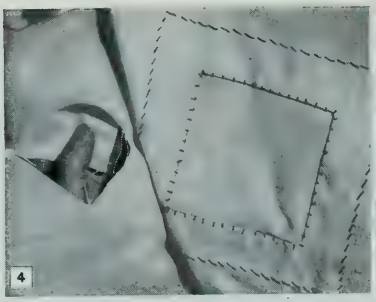
Leather palm with metal thimble protects sailmaker's hand as needle is driven through sail and patch. Pressure with left thumb "breaks" needle into the clear



How a patch is sewed over a straight-line tear similar to one at left. Sewing the patch to the canvas is the first step in making the repair. Edges are tucked under



With the patch in place, the canvas is reversed and the sail is sewed to the patch. At ends of the tear, cloth is cut diagonally and tucked under



Patch at the right repairs an L-shaped rip similar to one shown at the left. Procedure is the same as that employed in repairing the straight-line tear

Minor tears, both straight and L-shaped, are mended with herringbone stitch like that shown above. No patch is used. Herringbone stitch is self-locking

also called the round stitch. Note the position of the left hand in Fig. 1. The cloth is grasped between the thumb and the left fore and middle fingers. As the needle passes through the cloth in making the stitch, it touches the middle finger and simultaneously the thumb presses the cloth down, causing the point of the needle to emerge or "break." This finger action produces stitches of a uniform length and, although the procedure requires considerable skill, it can be mastered with practice. Fig. 2 shows a patch sewed over a short straight-line tear like that shown at the left in the photo. First, the patch is sewed to the sail with the edges tucked under, Fig. 2. Then the sail is sewed to the patch, Fig. 3. Diagonal cuts are made at each end of the tear and the edges of the sailcloth are tucked under as the sewing proceeds.

In all photos showing the stitches, black twine was used for purposes of clarity. In actual practice, white twine is used almost exclusively. Figs. 1, 2 and 3 do not show all the movements in completing a stitch, nor do they show the natural position of the hands in actual practice. As an example, the fingers of the right hand, Fig. 1, are shown much higher than they would be in normal procedure. This has been done in order to show clearly the position of the needle. After the needle has been pushed through by the palm, it is grasped firmly by the thumb and forefinger of the right hand and pulled through to tighten the twine. In mending sail, the twine is never tugged at the completion of the series of stitches. It is merely pulled taut and to a light tension. The twine is never knotted, at either the beginning or finish ends. In all patching, the edges of the patch, as well as the torn edges of the sail covered by the canvas patch, are tucked under to prevent fraying of the cloth. Ordinarily, the patch is cut from material of the same weight as that of the sail and it is cut to a width that will extend it at least 3 in. on each side of the tear before tucking. Sailmakers use several methods of locating the patch correctly over the tear. A short tear offers little difficulty but a long rent or one that is L-shaped requires more care, Fig. 4. It's important to make sure that the patch extends an equal distance beyond the limits of the tear at both ends. About 3 to 4 in. is a good average. Long patches can be tacked temporarily to the sail with several stitches at intervals along the length. Old sailmakers frowned on this practice, however, as they found there is a possibility of a patch applied in this way causing unequal tensions in a large sail. Perhaps the best practice in applying fairly large patches is to spread the sail on a flat surface, smooth all the wrinkles out of the canvas, then mark the location of the patch on the cloth. The marks on the sail make it easy to locate the patch as the sewing proceeds. Sailmakers usually start the first stitch about halfway along the length of the patch. The initial stitch goes down through the sail and patch and back up and the twine is pulled through until only about 3 or 4 in. of the end remain. This free end is then folded under the tuck where it is locked in place by subsequent stitches. At the finish end of the stitch, the twine is carried back under several loops and cut off.

The herringbone stitch, Figs. 5 to 8 inclusive, is used in repairing snags, small rips and tears, both straight-line and L-shaped, and also for mending the tears that develop around grommets, Fig. 7. It is self-locking and exceptionally flat and, when carefully made by a skilled workman, it results in a neat and permanent repair. Figs. 5 and 6 show the start and end of the

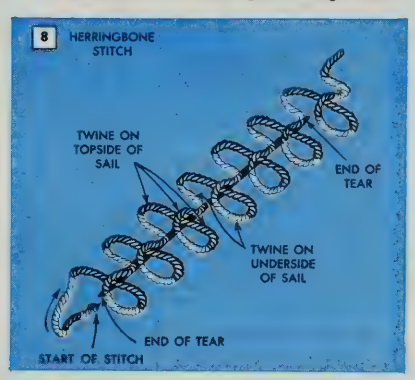
6

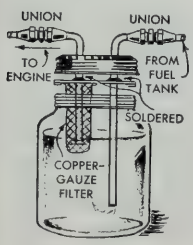
The completed herringbone stitch with the finish end about to be cut off. Some sailmakers return the twine through several loops before cutting the end

7

The herringbone stitch also is used to repair tears around grommets. In making the repair, one loop of each stitch passes around the grommet ring as shown

stitch and Fig. 8 details the procedure quite clearly. Note in Fig. 8 that the dark-shaded portions of the twine are on top of the cloth while the lighter portions are underneath. With this in mind, it is easy to follow the course of the needle and twine above and below the cloth. The stitch is started as in Fig. 8 by forcing the needle through the cloth, then back up and through to the underside again. Next, the twine is carried to a point just about opposite the end of the tear and about ⅜ in. to one side of it. Then the twine is brought up through and across to an equal distance on the opposite side of the tear where it is passed again through the cloth and brought up through the tear. From here it is taken over the first loop and down through the tear. This completes the first individual stitch. The trick in making a smooth, neat repair without bulges or wrinkles is simply to maintain an even tension on the twine as the individual stitches are made. A common method of ending the stitch is to cut the twine as in Fig. 6 about ½ in. above the cloth. Another acceptable method is to pass the needle through several loops and then cut the twine just back of the last loop. In repairing the cloth around grommets, one loop of the stitch passes around the grommet ring, Fig. 7. This type of grommet repair cannot be considered permanent, although it will last throughout a full season unless the sail is old and weakened by weathering. Holding the sail on the lap permits free left-hand movement.





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